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ABSTRACT

This publication details the development and use of environmental education materials based on the United States Forest Service "Process Approach." This publication focuses on materials that teach the ecology and management of natural and man-made forest and brush fires. The main body of the contents develop and document a rationale for environmental education and the process approach. In the main body, a summary of the ecological effects of fire and the development and evaluation of the teaching materials is discussed. An extensive bibliography is included. The appendices include: (1) the evaluation survey package and summary of survey responses; (2) a land use simulation game presently used in workshops on the man-fire-environment relationships; (3) a slide/tape program script entitled "The Other Side of the Flame"; and (4) an analysis of simulation games. (MR)

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Development
of
Environmental
Education
Materials
for
Investigating
FIRE - ENVIRONMENT - MAN
Relationships

SE 024 565

FINAL REPORT:

THE DEVELOPMENT OF ENVIRONMENTAL EDUCATION MATERIALS FOR INVESTIGATING FIRE-ENVIRONMENT-MAN RELATIONSHIPS

Product of
Cooperative Agreement No. 42-185
between
The Research Foundation of State University of New York,
SUNY College of Environmental Science and Forestry
and
Northeastern Area, State and Private Forestry,
Forest Service, U. S. Department of Agriculture

Study Title:
Providing a methodology for instructing land managers and educators so that they, in turn, are prepared to teach basics of fire ecology and fire management to general publics

June, 1975 - June, 1978

Note: A 16mm sound color motion picture depicting the environmental education techniques of this study and titled, Contact--Where Are We? is being submitted under separate cover.

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INTRODUCTION AND EPILOGUE

> "It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness, it was the epoch of belief, it was the epoch of incredulity, it was the season of Light, it was the season of Darkness, it was the spring of hope, it was the winter of despair, we had everything before us, we had nothing before us, we were all going direct to Heaven, we were all going direct the other way -- in short, the period was so far like the present period that some of its noisiest authorities insisted on its being received for good or evil, in the superlative degree of comparison only."
>
> Charles Dickens
> *A Tale of Two Cities*

Although Charles Dickens was writing about England of the early 1700's, his description could just as easily apply today. For many of us, this is indeed the best of times. It is a time of individual prosperity and general societal well-being that is unmatched in the world. The turmoil that marked the 1960's and early 1970's subsided as the Americans left Vietnam and as former President Nixon relinquished the presidency. Compared with the 1960's, one could easily call this era the serene seventies. Yet our era can also be characterized as seductive. In 1963 Stewart Udall wrote: "America today stands on a pinnacle of wealth and power, yet, we live in a land of vanishing beauty, of increasing ugliness, of shrinking open space, and of an overall environment that is diminished daily by pollution, noise, and blight." Things do not appear to have changed much. We still face those critical environmental problems and more; problems of such magnitude and scope that they threaten our survival -- individually, culturally, nationally, internationally, globally. Yet the quietness, the feeling of well-being, is seductive, lulling one into a false sense of security. It is easy to assume things are going well and repeat the mistakes of the past. So while the best of times, our era could easily become the worst of times, an age of foolishness.

I spent four years in the Air Force as an enlisted man. Many of the regulations I encountered seemed to exist to make sure that if something went wrong, the blame could be traced back to someone or something. This concern with finding "the cause" (singular) is not restricted to the armed forces, but is very much a part of all our lives. It is not surprising then, that when the quality of the environment became a major issue, there were many attempts to nail down the responsible party, factor, institution, etc. Commoner (1972) notes that, in turn, rising population, affluence, industry, man's innate aggressiveness, the knowledge he acquired, profits, religion, technology, capitalism, and the "disaster lobby" have all been blamed at one time or another for our environmental problems. He goes on to say "... one keen observer blamed everyone: We have met the enemy and he is us -- Pogo." We are, or more accurately our culture, is at the heart of our environmental problems. Culture is man's short cut to biological adaptation. Through it he has been able to adjust to many different situations and environments. But it has proven to be a two edged sword -- making possible all the accomplishments of the past and present, and, in doing so, led inevitably to the environmental problems we face today. The emphasis on growth, orientation to success (and the accompanying material embellishments), and equating better with bigger have only been a few contributing culturally related factors. These, combined with the technological revolution that followed World War II that gave man the power to pursue his ends as never before (Commoner, 1972), has brought our society to a crossroads. Basic changes are needed -- changes that will be hard to make.

One of the major obstacles to these changes is that environmental problems are not "here and now." They only fit half the requirement -- they are here. This means they exist but are masked by a number of factors, not the least of which is the length of time of the "crisis." The fact that the "crisis" can extend over many years robs it of its potency and a sense of urgency is lost. As urgency fades, so does action. The problem is "here" but not "now"; and our country seems to require a "now" to get moving. Witness the events leading to our involvement in World War II. The problems with Germany and Japan were there -- they were inevitable. Yet until the problem became a "now" -- Pearl Harbor -- the United States withheld total commitment. Perhaps the problem lies in a lack of perspective, an inability to see problems that stretch over long periods of time or that do not have an easily identifiable focus point. The latter is like the point vs. nonpoint source pollution problem. Point sources have a nice, easily identifiable point at which to attack the problem. Treatment can be accomplished technologically, without affecting the process generating the pollution. Nonpoint sources have no single focal point which can be dealt with easily. Treatment must affect the process itself -- a much more difficult task. The same is true of the environmental "crisis" in general. There is no one single point of attack, no way to leave the process -- the way we live -- intact and still solve the problems.

Generating and/or increasing people's awareness of their lifestyles impact on their life support systems and trying to convince them changes are needed is a big job. A kind of "social inertia" -- the tendency for society to resist changes in the way it lives -- has to be overcome. People as a whole are notoriously reluctant to abandon or even change their ways, especially if sacrifices in comfort or convenience are involved. The resurgence of big car sales (in 1976 Cadillac had its best year ever) in the face of increasing gasoline prices and despite the events of the winter of 1974, is only one example of this reluctance. Yet changes must occur in the way we live, in our expectations and in some of the basic assumptions our society has made in the past if we are to successfully deal with today's environmental problems and those of the future. Society can no longer afford to consider itself apart from the natural world or maintain what Boulding (1970) calls a "cowboy economy" (one based on the assumption of an unlimited ability of the natural ecosystems to process waste and unlimited natural resources). Aldo Leopold's call in 1949 for a "land ethic (that) .... reflects the existence of an ecological conscience and .... a conviction of individual responsibility for the health of the land" is still valid today.

Finally, the "environmental issue" has had to compete for attention (and sometimes conflicted) with other potent issues. Schoenfeld (1975) comments: "...if (Earth) Day had been scheduled for May 22, 1970, instead of April 22, I doubt if it would have come at all, at least not on college campuses. Because in mid-May, 1970....the energies of millions were being consumed by a fervent backlash to Mr. Nixon's Cambodian incursion." Cambodia and Vietnam were followed by the business recession of the early 1970's. Suddenly it became painfully obvious that environmental protection could cost jobs as well as money. One can't junk automobiles without junking automobile workers Schoenfeld (1975) points out. Then came Watergate, and most recently, the energy crunch. First was the gasoline shortage in the winter of 1974: "'These people are like animals, says Don Jacobson, who runs an Amoco station in Miami, 'if you can't sell them gas, they'll threaten to beat you up, wreck your station, run over you with a car.'" While reactions were not always that bad, lines were long and, as was remarked in Time magazine: "For millions of Americans happiness is a full tank of gas." Then came the bitter winter of 1976, layoffs and school closings due to fuel shortages. Some people had to face the possibility of reduced or no heat for their homes. Against this backdrop, the Trans-Alaskan pipeline was rushed to completion over the objections of environmentalists. So, by the middle of the 1970's, the "environmental issue," once right up there with motherhood (which incidentally is also in trouble!) and apple pie, had its sacrosanctity punctured and so became fair game.

Despite the obstacles, though, some progress had been made. The seventh annual report of the Council on Environmental Quality (CEQ, 1976) noted that for several major air pollutants (carbon monoxide, total suspended particulates, and sulfer dioxide) most of the nation's 247 Air Quality Control Regions have met or can meet (by early 1980), the primary health-related air quality standards and on the whole, air quality is improving significantly. The National Environmental Policy Act (NEPA) was signed into law in 1970. While earlier federal acts had been passed to attack specific environmental problems (Clear Air Act, 1963; Federal Water Pollution Control Act, 1956), NEPA was the first to require consideration of the impact of federal decision on the environment as a whole. Furthermore, federal agencies were required to put those considerations in writing in the form of Environmental Impact Statements (EIS) for each decision. These EIS's are available to the public and have opened the way for greater public input into the federal decision-making process. The federal NEPA was soon followed by "little NEPAs" at the state level. By January 1, 1975, thirty-two states had legislatively or administratively established NEPA equivalents (Burchell and Listokin 1975), extending the consideration of environmental factors into the state and sometimes even local planning processes.

Citizen involvement is increasing -- something Snyder (1974) attributes to a greater public mistrust of institutions leading to increasing willingness to actively monitor them. In addition, things that in earlier years would have been considered as progress and gone unquestioned, are now being challenged. For example, the Supersonic Transport, once regarded as the next step in commercial aviation, ran into a storm of protest in the United States and was eventually abandoned. For once, bigger and faster was not better.

There is no question that things have been getting better, but more is needed. Almost all of the improvement so far has been via technology -- treating the symptoms of the problem (e.g. waste water treatment plants, fly-ash precipitators, auto smog devices, etc.) But while technology is important, the answer does not lie there alone. The events of the recent years have exploded the "Myth of Scientific Supremacy"[1] as Udall (1963) calls it. Rather people need to be aware of and knowledgeable about their environment, its complexity and inner workings, of the impact their actions (both individually and as a society) have on it, possible alternative approaches to problems, and contributions they can make and how they can become involved. In short, people need to be "environmentally educated."

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[1] The rationalization that scientists can fix everything tomorrow.

Chapter 1

Environmental Education
A Basic Consideration

1.1 Introduction

According to Greek legends, Aphrodite, goddess of love, sprang fully formed from the foam of the ocean. Unfortunately, Environmental Education (EE) wasn't that lucky. Schafer (1975) notes "Although the basic concepts of EE have been evolving over many years, it was not until the late 1960's that the movement gained an identity and began establishing itself as a major educational concern." Just how many years is pointed out by Bottinelli (1977) who notes that the Committee of Ten, in their secondary school studies, urged botany teachers to take an ecological approach to their topic -- in 1893. The evolution of EE has been the subject of several writers (Hawkins and Vinton, 1973; Stapp, 1974; Swan, 1975; Bart, 1975; Nash, 1976; and Bottinelli, 1977). The consensus of opinion seems to be that EE grew out of three older "educations": Conservation Education, Nature Study, and Outdoor Education. Conservation Education stresses the importance of natural resources (Swan, 1975) and their "wise" and "efficient"[2] use (Bottinelli, 1977). Nature Study's emphasis is more on the emotional, moral, and aesthetic (Bart, 1975; Bottinelli, 1975) and stresses first hand contact with living things in the field. Outdoor Education is also concerned with direct contact with the outdoors, but for any curricular area that applies (Swan, 1975; Bottinelli, 1977). The philosophy, as Dr. L. B. Sharpe points out, is that what is best learned outdoors, should be learned there (Freeman and Taylor, 1961). With the advent of a new environmental awareness in the 1960's, educators in all three fields began to see a need for a new "education," one that went beyond the confines of their field, and stressed the interrelated and interdependent nature of the environment and man's interactions with it (Bart, 1975). Yet while Conservation Education, Nature Study, and Outdoor Education have been important influences in the development of EE, they are not the only ones. The roots of EE also extend beyond them into changes in educational thinking as a whole. Clues to this lie in discussions of EE and education in general.

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[2] Of course, there were (and are) always differing opinions as to what a "wise" and "efficient" use is.

1.2 EE Defined?

Defining EE turns out to be a difficult process. Webster's New Collegiate Dictionary (1975) defines environment and education as the following:

"Environment:	The circumstances, objects, or conditions by which one is surrounded.
Education:	The action or process of education or of being educated (educate: to develop mentally or morally, especially by instruction)."

Using these definitions, EE becomes the process of developing mentally or morally with respect to or concerning one's environment. But what exactly is one's environment? Usually it is assumed to mean everything outside of an individual's body that influences them. McInnis and Albrecht (1975) however, define environment as "The synergistic sum of all influences upon an organism (plant or animal). For man this includes all biological, chemical, physical, social, psychological, esthetic, and unknown surroundings (emphasis author's)." In short, one's environment could include everything, making EE developing mentally or morally with respect to everything, a rather all inclusive definition and not much of one at all. Given this problem, one must look further.

Many writers have concerned themselves with defining EE. Those definitions this writer has reviewed seem to be stated in terms of goals and/or characteristics. An example of the former is the definition by Stapp (1969): "(EE is) aimed at producing a citizenry that is knowledgeable concerning the bio-physical environment and its associated problems, aware of how to help solve those problems, and motivated to work toward their solution." Kormandy (1971) writes: "EE must have as a fundamental aim an alteration of attitudes based on understanding and appreciation of man's place in the nature of things." Finally, Bogan (1973) notes that "EE is the process that fosters greater understanding of society's environmental problems and also the processes of environmental problem-solving and decision-making." The emphasis here is bringing people to a certain point. Although the definitions vary, there is some common ground. Awareness (of self, surroundings, problems, etc.), knowledge (of self, surroundings, problems, etc.), and processes with which to gain and use knowledge, are all goals commonly mentioned in one way or another.

Others use characteristics:

Clark (1975):	"...EE is a process....interacting with environments. It demands involvement, it is active, ...it is participatory and experiential."
Nash (1976):	"The lowest common denominator of the many varieties and levels of EE is a multidisciplinary, problem-oriented approach."
Hawkins and Vinton (1973):	"It (EE) is an integrated process involving experience, investigation, and problem-solving in man's natural and man-made surroundings, using the total human, natural, and physical resources of the schools and the community of the educational library."

Here the emphasis appears to be on the means. Again, although the terms vary, terms such as "multidisciplinary," "participatory," "active," "integrated," "problem-solving oriented" are common.

Perhaps some additional insight into what EE is can be gleaned by considering what it is not. Clark (1975) points out that EE's relevance is not confined to biology, science, or nature study. Ritz (1977) adds to this by cautioning against defining EE in terms of environmental science: "By placing an over emphasis on environmental science, we risk shutting out a large constituency of teachers who might otherwise be ready for EE."

Nor is EE regarded as a separate subject to be added on to existing curriculum (Arnstein, 1971; Clark, 1975; Tanner, 1974). Most writers see it as being integrated into already existing curriculum.[3] Related to this, are the comments of a committee report on Elementary and Secondary Education for a 1975 conference on EE: "A myth has been promulgated that Environmental Education is a body of knowledge complete with a delivery system for content, skill development, and concept awareness." If this were not a myth, but true; then a separate course would make sense and eventually a definition would evolve expressing the limits of the discipline and identifying the delivery system.

---

[3] There is a little disagreement on this. Galushin and Doraiswami (1973) list a separate course (on par with other school subjects)

This has not happened as yet. In fact, if there is one thing on which there seems to be agreement, it is that there is no single, widely accepted definition of EE (Tanner, 1974; Disinger, 1975; McInnis, 1975; Bottinelli, 1977). The committee on Communications and Dissemination, in their group report for the 1975 Snowmass, Colorado conference on environmental education, described the term EE as "vague, amorphous, and currently undefined" (Hanselman, personal communication).

Why this problem in definition? Certainly part of it, as mentioned above, lies with the "environment" part of EE. EE, unlike the "ologies" (biology, meteorology, etc.) is not subject limited. The difficulty, however may go deeper than that, and is related to the myth

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as one of three ways to incorporate EE into a school's curriculum. McInnis (1972), on the other hand feels that adding a separate course just adds another specialized course and defeats the interdisciplinary idea of EE. While thinking of EE only as a separate course or subject is self-defeating, there is no reason why specialized environmental courses cannot be offered as EE, provided EE is also infused in the rest of the curriculum.

mentioned above. Rather than being a specific body of knowledge about a subject, EE is an educational philosophy -- a way of thinking. This makes it subjective, and subjectivity makes widespread agreement on definition extremely difficult. Given this, the lack of universal definition is understandable, even expected.

Earlier it was stated that the development of EE had been influenced by changes in educational thinking. Specifically, this refers to a reform movement that developed in the late 1950's and early 1960's, and is still going on today. This writer feels that some useful insights might be gained by looking briefly at this reform movement and it's possible relationship to EE.

1.3 Educational Reform and EE

In 1916, John Dewey wrote: "That education is not an affair of 'telling' and being told, but an active and constructive process, is a principle almost as generally violated in practice as conceded in theory." Fifty-eight years later Swan (1974) observed "Education is a process, not a product; yet most educational programs are geared toward teaching people what to think rather than how to think." Things do not appear to have changed much. The almost total concentration on content has been a major criticism of our educational system. Bruner (1973) and Hawkins and Vinton (1973) attribute it to the need to acculturate the flood of immigrants during the first part of the Twentieth century -- a situation that no longer exists. Students are learning masses of data that have little or nothing to do with what goes on outside school either before or after graduation. Other criticisms include:

1. Authoritarian orientation. Samples (1970) calls education "orchestrated coercion." Anyone who has attended school for any length of time will understand what he means. While some amount of structure is necessary, the obsession that schools sometimes exhibit can keep students in what Silberman (1971) calls "....a state of chronic, almost infantile, dependency," resulting in, he adds, "teach(ing) students every day that they are not people of worth, and certainly not....capable of regulating their own behavior."

2. Teacher centered. The teacher is the primary figure of authority and beyond that, what Mallan and Hersh (1972) call a G.O.D. -- Giver of Directions. One of the main functions of a G.O.D. they say, is to dispense truth and knowledge. "Knowledge" (facts, figures, memorized information) flows (one way) to those who do not know (students) from one who does (teacher). Education becomes a matter of transmission of "knowledge" (Crowell, 1971).

> "Beware of any one who has Answers. There are no answers, only directions of travel. We can never know all the aspects of a single grain of sand. But we can set goals and work toward them, at the same time modifying them in the light of experience."
>
> -- Earl Wajdyk, 1972

3. Passiveness. The description of higher education in the President's Commission on Campus Unrest (1970) could be applied

to any level of education: "The student's role in this process of education is largely passive: he sits and listens, he sits and reads, and sometimes he sits and writes. It is an uninspiring experience for many students."

4. Past oriented. One recognized function of school is the enculturation of children and adolescents (Dewey, 1916; Bruner, 1973). This consisted primarily of presenting the past so it would be preserved in the next generation of adults. This made sense as long as the future was like the present, which in turn was like the past (Michael, 1974). This assumption, however, may no longer hold true, creating the possibility that schools are educating for conditions that may not exist in the future (Toffler, 1970).

5. Disjointed Curricula. Subjects in school are taught in isolation and, like cars on a freeway, their only contact is through accidental crashes. Dewey (1930) concludes that this segregation "disconnects" subject matter from the rest of experience and makes

> "Find, if you can any similarity between geography as presented in the usual textbook and geography as practiced by geographers. The problems are presented as solved at the outset. The child is then asked to consider how the 'authority' arrived at his solution. In a geography text we find at the beginning of a chapter the statement 'The world can be divided into temperate, torrid, and frigid zones.' Virtually the whole of the effort in the paragraphs that follow is given over to making it seem as if this distinction is obvious. Many children, we are convinced, are left with the image of an earth in which one can find border signs which read something of the order, 'You are now entering the temperate zone.' put there by some benign authority in league with the textbook."
>
> -- Jerome S. Bruner, 1973

it unavailable under real life conditions. Problems in real life add Hepburn and Simpson (1975) do not come labeled "biology," "geography," "chemistry," or "sociology."

Since environments themselves are educational, learning is not confined to course content (McInnis, 1975). Students also learn from the way the course is structured and the atmosphere created by the instructor and the school as a whole. In short, what students do in the classroom (and what is done to them!) is what they learn (Postman and Weingartner, 1969). Given these criticisms, some educators were (and are) concerned about what people were learning in school. Out of this concern grew an alternative view of educational and a search for strategies to implement it: "School must be a place to prepare young people to take their place in society -- not a place where we isolate them from the main currents of life -- and this can be done by making education at every age level person-centered, idea-centered, experience-centered, problem-oriented, and interdisciplinary, with the community and its other institutions a part of the process..." One of the primary goals of this education is to get people to "learn to learn" -- to become autonomous learners (Bruner, 1963; Silberman, 1970; Nyquist, 1972), and beyond that effective problem solvers.

All this should sound familiar to an environmental educator. Both Stapp (1969) and Bogan (1973) stress problem-solving ability as an outcome of EE. In addition EE has also been described as experience-oriented (Hawkins and Vinton, 1973; McGowan and Kriebel, 1975; Bottinelli,

1977) and interdisciplinary (Staff, 1970; Nash, 1976; Schafer, 1975). The humanistic orientation implied in Gross's (1972) statement: "Respect for and trust in the child are perhaps the most basic principles underlying the open classroom" and Nyquist's description ("person-centered") is also found in EE (McInnis, 1975). Finally, EE also views the community as an educational resource (Berry, 1975; Milmine, 1975; Bennett, 1975).

Similarities are not necessarily proof of relationship. Yet the large amount of overlap in goals and methods between EE and the earlier education reform movement strongly suggests one. Sometimes the only difference between the two is the word "environmental" inserted periodically in the definition of EE. For example, in discussing definitions of EE, Bart (1975) cites the following:

> "EE is the process that fosters greater understanding of society's environmental problems and also the processes of environmental problem-solving and decision-making. This is accomplished by teaching ecological relationships and principles that under lie those problems and showing the nature of possible alternative approaches and solutions. That is, the process of environmental education helps the learner perceive and understand environmental principles and problems and enables him to identify and evaluate the possible alternative solutions to these problems and access their benefit and risks. It involves the development of skills and insight needed to understand the structure, requirements, and impact of interactions with and among various environmental entities, subsystems, and systems."
>
> (Bogan, 1973)

She then calls this somewhat of a non-definition because "....it uses a description of methods and goals of EE in place of an explanation of the term itself. If the word 'environmental' was omitted from the definition, one would simply have the definition of a good education." (Bart, 1975; emphasis author's). Yet considering: (1) The implication in the meaning of the word environment, (2) The desire expressed by McInnis (1972) and others to avoid the "separate discipline" trap; and (3) The objective of both EE and education in general to prepare people for productive roles in society; doesn't EE ultimately become "a good education?" How much of a distinction is there?

There are some differences. In some respects, EE is broader in scope. The target of educational reform has been the educational institutions -- schools and universities -- whereas EE is considered aimed at all age brackets (Rillo, 1974) and extends into the community (Clark and Stalpes, 1975). And, while EE is concerned with the educational process as a whole, it places special emphasis on the relationship between man and the natural systems that are his life line.

In summary, EE is commonly considered an outgrowth of Conservation Education, Nature Study, and Outdoor Education. While a great deal of what EE is comes from these three older "educations," the similarity of methods, goals, and philosophy indicates that the general education reform movement made major contributions to EE's heritage.

1.4 Description and Definition

The above review of the literature has led to the conclusion that EE cannot be tied up in a neat, universally acceptable definition. Two factors have led to this conclusion:

(1) The all inclusive nature of the "environment" part of EE.

(2) The perspective that EE is a way of thinking about, or looking at, education and so subjective in nature.

These factors have also led to the conclusion that, although there is common ground, ultimately EE is defined on a personal level: its characteristics, limits, goals, methods, content, etc. determined by the individual concerned.

Through readings and conversations with others involved in EE, the author's conception of EE has begun to crystalize around two aspects of it: (1) How it is done, and (2) Why it is done.

1.4.1 Characteristics

How it is done refers to EE characteristics, what could be called the "descriptive nouns" of EE: active, interdisciplinary, use of community resources, integrated, oriented toward participation and experience, problem-solving, learner-centered, etc. These evoke the image of an educational process in which the learner is an integral part, not one in which he is the target of educational slings and arrows. There may be, however, exceptions. Bogan (1973) acknowledges the need for such strategies, but goes on to say "....in certain cases EE must operate through more traditional approaches, such as lectures, classroom activities, and other non-experience oriented methods if the learner is to attain some of the essential skills, concepts, and facts he needs." While EE efforts should strive for the kind of active, learner-centered educational process described earlier, the recognition should exist that situations will arise where it is not possible or appropriate. This does not mean the attempt should be abandoned, only that alternative methods should be explored.

One characteristic that has not been included and which deserves comment is the call for a man-centered environmental ethic or EE effort (Hawkins and Vinton, 1973; Butterfield, 1970; Hill and White, 1969). A word of caution here. While man's relationship to his surroundings is an extremely important aspect of EE, an exclusively man-centered EE may inadvertently reinforce the idea that the earth exists solely for man's use, by stressing his importance either directly or by inference. Such an idea has been credited as one of the many factors behind our environmental problems today (Brubaker, 1972; Laszlo, 1972; Larsen, 1972) and is like, according to Mark Twain, assuming that the Eiffel Tower was built to support the thin layer of paint at its peak. McInnis (1975) has pointed out that "....conceptual models for EE tend to be _ego_-centric rather than _eco_-centric.... Humankind tends to be portrayed as the most important species on the planet, when, as the final species in the food chain, we are actually the most expendable." The contrast here lies between a self-view and one based on relative importance in the workings of the eco-system. Removal of plants would spell disaster for the biosphere, while removal of man would not greatly affect its functioning. Efforts should be made in EE to maintain a perspective, distinguishing man's importance as he views it, from his actual role in the functioning of the eco-system.

1.4.2 Goals

Why EE is done involves looking at goals. As with education in general, the goal of EE is to help and prepare learners to function in society[4] while offering a chance to grow personally. To accomplish this, the author feels that EE should have goals in three related areas: awareness, knowledge, and process or "use" goals.

Awareness goals are oriented toward making the learner conscious of some aspect of the environment. These goals extend beyond the realization that pollution exists, into a sensitivity to natural systems, their complexity and interrelated nature. People should also be aware that man has an impact -- a very significant impact at times -- on natural systems and that any action he takes that affects these systems involves making tradeoffs, regardless of size (e.g. in many areas, man has exchanged clean air for the convenience of the automobile). Finally, considering the meaning of environment, a logical extension can be made to self-awareness. Awareness is not limited to a gross or very unsophisticated level but can also be detailed and highly sophisticated or anywhere in between (Kraithwhol et. al., 1964). Thus an individual can be aware that interrelationships exist in natural systems or, on a higher level, be conscious of differences in those relationships.

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[4] This does not mean the educational system should run learners through an educational machine and stamp them into one uniform societal "piece." Rather, it should help learners discover how they best "fit in."

Knowledge goals begin with producing people knowledgeable about the natural systems on which they depend. These goals also involve investigating man's impact on those systems. How does he affect them? What problems has man's impact caused or might cause? What are alternative approaches to problems and solutions? How do natural systems affect him? These goals should also consider the social institutions that make up part of man's environment -- particularly governmental ones since our country is founded on the notion of citizen involvement. Overall, knowledge goals are concerned with imparting information and increasing understanding. As conceived here, knowledge would include the category of knowledge and elements of the category of comprehension defined by Bloom, et. al. (1956) in their taxonomy of behavioral objectives. Accomplishing knowledge oriented goals would give people a basis with which to evaluate decisions and/or actions of their own or others, helping them determine if they wish to become involved.

Obviously there is a relationship between awareness and knowledge. Krathwhol, et. al., (1964) points out that being conscious of something is a prerequisite to knowing about it. One could also say the reverse, creating a "chicken and egg" situation. However, increasing awareness is not always a function of acquiring more knowledge (i.e., the facts and figures kind). Increasing awareness can also occur through experiences designed to heighten sensory contact with the environment, such as in Van Matre's (1972, 1974) Acclimatizing program.

The third set of goals are process of "use" oriented. These are primarily concerned with transmitting skills to the learner. The "learning to learn" process mentioned earlier is one. Others include application of acquired knowledge, strategies for becoming involved in an issue, problem-solving and decision-making skills, and even what Postman and Weingartner (1969) call "crap detecting."[5] Unlike facts and figures, skills such as these cannot be directly transmitted by the instructor to the learner (Taba, 1966). Rather the learner can be put into a situation that emphasizes the use of such skills. For example, an instructor could have students investigate recycling (what it is, how it is done, pros and cons), explore possible applications to community situations, and, based on the outcome of the exploration, take action. The latter -- take action -- may involve advocacy (e.g. try to get people in the community to change their attitudes toward recycling in some specific way deemed desirable by the students). At this point a distinction should be made between EE and advocacy. EE should stress showing people how to take action if they so desire, to accomplish goals they wish to attain. Thus EE

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5 Postman and Weingartner (1969) describe "crap detecting" as follows: "One way of looking at the history of the human group is that it has been a continuing struggle against the veneration of 'crap.' Our intellectual history is a chronicle of the anguish and suffering of men who tried to help their contemporaries see that some part of their fondest beliefs were misconceptions, faulty assumptions, superstitions, and even outright lies. The mileposts along the road of our intellectual development signal those points at which some person developed a new perspective, a new meaning, or a new metaphor. We have in mind a new education that would set out to cultivate just such people -- experts at 'crap detecting'."

becomes, in part, a means to provide learners with a means. Advocacy, on the other hand, emphasizes persuading people to accept the advocate's point of view, to bring them to an end the advocate wishes them to attain. Although the author does not regard EE and advocacy as synonymous, EE can lay the groundwork for advocacy by providing information and processes. Thus in the above example the processes in which the students were engaged can be considered EE. What they may have been doing -- advocating a specific point of view on a specific issue -- was not.

However, because attitudes are involved, the distinction is not always easily made. In fact, determining the extent to which education in general should be involved in generating or changing attitudes is difficult. In discussing why affective objectives have received much less emphasis than cognitive ones in education, Krathwhol et. al. (1964) note that, in our society, a person's beliefs, attitudes, and values are regarded as private matters. Consequently, Krathwhol et. al. add:

> "Closely linked to this private aspect of affective behavior is the distinction frequently made between education and indoctrination in a democratic society. Education opens up possibilities for free choice and individual decision. Education helps the individual explore many aspects of the world and even his own feelings and emotion, but choice and decision are matters for the individual. Indoctrination, on the other hand, is viewed as reducing the possibilities of free choice and decision. It is regarded as an attempt to persuade and coerce the individual to accept a particular viewpoint of belief, to act in a particular manner, and to profess a particular value and way of life. Gradually education has come to mean an almost solely cognitive examination of issues. Indoctrination has come to mean the teaching of affective as well as cognitive behavior."

They go on to say that the separation of the two is not as simple as the above suggests and a reopening of the question would help see the boundary between education and indoctrination more clearly. The same problem exists in EE. Where does environmental education end and environmental indoctrination (or advocacy) begin? The desirability of some attitude changes are hard to dispute. A positive attitude toward the natural systems that are man's lifeline or the perception of natural resources as having limits are two examples. However, the more specific the attitude change sought becomes, the more it moves out of the realm of EE and into that of indoctrination. Defining specifically how one wants people to react relative to a specific issue in a specific situation and constructing an experience designed to produce that result certainly smacks of indoctrination. For example, take the two objectives:

(1) Given the solid waste situation in Syracuse, N.Y., the individual will exhibit a positive attitude toward recycling bottles by (a) using returnable bottles, and (b) taking action politically to support bottle recycling (e.g. write a letter to the city council, attend and speak out in favor of recycling bottles at a hearing.)

(2) Given the solid waste situation in Syracuse, N.Y., the individual will be able to evaluate the possible application of recycling bottles to it, take action based on his evaluation, and logically explain the reasoning behind that action.

Which one suggests the instructor has the "right" answer or attitude and is "passing it on" to the learner? In which learning experience would one expect to find learners forming their own attitude? In which one is the learner more likely to assume that recycling is "the answer?" This example points out the need to carefully consider the role of forming or changing attitudes in EE and its implications.

There is no question that EE will involve some attitude changes. However, such changes should be on a general level, and leave more specific decisions concerning attitudes up to the learner, with experiences designed to allow the learner to do so. The author agrees with Hende's (1972) assessment: "Personal freedom of opinion is of utmost importance and if environmental education places emphasis upon cultivating attitudes at the expense of full information about alternative societal actions, then it too can become a repressive influence."

The fact that knowledge, awareness, use and goals have been discussed separately should not imply they are accomplished separately, or even in the order in which they were discussed. Rather, like the environment, they are interdependent and interrelated (figure 1-1). Accomplishing one may lead into others or they may even be accomplished simultaneously (Kraithwhol, et. al. 1964). An investigation of soil, for example, may generate awareness of the complexity of soil ecology and increase knowledge at the same time, while the generalized process used in the exploration could contribute to the acquisition of process skills. Furthermore, the total experience could contribute toward developing a positive attitude toward natural systems as a whole. Purposely and consistently attempting to separate these goals is, in fact, creating an artificial situation, distorting what happens in real life.

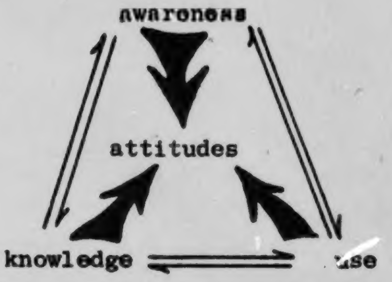

Fig. 1-1
Relationship of Goals

1.4.3 Working Definition

This has been a somewhat long description of EE, yet because it was an exploration in definition and a personal view, it was doomed to be so. Based on it, the author has defined EE as the following:

> "An educational process by which people: (1) increase their awareness and knowledge of their environment, its interrelated nature, their relationship to it, and their impact on it, on levels ranging from individuals to that of man as a whole, and (2) acquire skills to generate knowledge independently, identify goals, and take action to achieve those goals."

Ideally, educational experiences would be interdisciplinary, active, and learner-centered as possible, but the extent to which this can be done greatly depends on the situation under which they occur. Also, while attitude formation or change can be a part of EE, it should be directed at a general level and carefully considered.

Difficulty in definition does not make EE any less important. This writer believes our society is entering into a new and difficult era; one that will require a new understanding of the world around us and our relationship to it; and an ability of citizens to become involved in choosing alternative courses. EE can help make the transition.

Chapter 2

The Process Approach

2.1 Introduction

The increasing environmental awareness and evolution of EE brought an increasing demand by educators for ways to involve students with their environment. In the Northwest, this demand brought together eighteen educators who formed a group in 1970 to explore the development of EE materials. From their efforts a process approach to EE gradually evolved (McDonald, personal communication).

Carroll (1975) points out that the process approach program offered the United States Forest Service a way to bring resource management, education, and environmental factions together. In addition, there was also the realization that the general public needed a better understanding of environmental factors that affect resource management decisions. McDonald (personal communication) adds that such a program could take the school "show and tell" load off of agency people, something that, with increasing environmental awareness, was beginning to take a disproportionate share of time.

The Forest Service adopted a process approach workshop program as a major part of their EE effort. The thrust of the program was (and is) to acquaint people -- environmentalists, educators, resource managers, and whomever else was interested -- with a process approach to EE and possible uses for the methodology. Since this thesis is primarily concerned with the application of the process approach to designing investigations of the role of fire in the environment, the following discussion will concentrate on the process approach, touching on the workshop program only as it is relevant. More complete treatments of the workshop program can be found in Carroll (1975) and evaluation work by Hankin (in preparation).

The process approach has been defined by Carroll (1975) as "an orderly system of education that moves from a known body of data to, successively, the collection of more data, evaluation of the data formulation of hypotheses and concepts and the application of these in problem solving situations." The "orderly system" Carroll refers to, as presented in the workshops, extends beyond the interpretation-of-data/application process described in his definition. The process approach is made up of four interrelated components: (1) The investigative process around which it is based, (2) The questioning/task card strategy structuring the investigative process, (3) The discussion skills supporting and complimenting the process, and (4) An awareness of group dynamics.

2.2 The Investigative Process

The investigative process used involves moving learners from collecting and interpreting data, to applying what has been discovered. The basis for its structure lies in work by Taba (1966) and McCollum and Davis (1972). Taba regarded thinking as teachable and as an active transaction in which the individual used cognitive operations to derive information from it. She identified these processes as "organizing facts into conceptual strategies, relating points in data to each other and generalizing upon these relationships, making inferences and using facts and generalizations to hypothesize, predict, and explain unfamiliar data." (Taba, 1966).[6] Unlike facts, these thinking skills could not be given by the teacher. Rather the teacher could help learners acquire these skills by giving him/her the opportunity to use them while offering progressively less and less direct support. She also thought these operations formed a hierarchy and therefore, a teaching strategy designed to improve them should be sequential. Based on these assumptions, she developed an inductive instructional strategy involving three sequential cognitive tasks (table 2-1). She then experimentally tested her strategy and found that elementary students in classes using her method were superior to control groups in ability to discriminate, infer from data, and apply known principles to new problems.[7]

McCollum and Davis (1972) used Taba's work as the basic underlying structure for a workshop training program designed to help

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[6] These steps were later formalized to Concept Formation, Interpretation of Data, and Application.

[7] Taba (1966) acknowledges that the results from the written tests were not consistent. She notes that inadequate tests, variable composition of the sample groups, or variation in teaching style could have affected the results. Analysis of tape recordings made of classes, however, indicated that the teaching strategy seemed to make a difference in the productivity of thought as well as the type of thought in which the students engaged.

Strategy #1	Concept Formation		
	Phase One	Phase Two	Phase Three
	Enumeration and Listing	Grouping	Labeling categories
Strategy #2	Interpretation of Data		
	Phase Four	Phase Five	Phase Six
	Identifying dimensions and relationships	Explaining dimensions and relationships	Making inferences or generalizations
Strategy #3	Application of Principles		
	Phase Seven	Phase Eight	Phase Nine
	Hypothesizing, predicting consequences	Explaining and/or supporting the predictions and hypothesis	Verifying the Prediction

Table 2-1

Instructional Strategy Developed by Taba*

*After Joyce and Weil (1972)

teachers and others interested in developing curriculum produce educational experiences that would encourage the development of higher levels of thought processes (i.e. above memory/recognition level). To accomplish this, they wanted to "....develop (in participants) an understanding of and skill in, relating a structure of process to a structure of knowledge." (McCollum and Davis, 1972). The structure of knowledge to which they refer, shown in figure 2-1, contains four different levels arranged in a hierarchy, moving from specific to abstract. The structure of cognitive processes was taken from Bloom, et. al. (1956) and Sanders (1966). Bloom, with others, developed a taxonomy of educational objectives for the cognitive domain. They assumed the processes their objectives reflected formed a hierarchy. Simpler behaviors could be integrated with other simpler behaviors to form more complex ones. Consequently the taxonomy that evolved was hierarchal in nature, moving from simple (1.00) to complex (6.00):

1.00 Knowledge
2.00 Comprehension
3.00 Application
4.00 Analysis
5.00 Synthesis
6.00 Evaluation

Sanders (1966) felt that careful use of questions[8] by teachers could lead students into thinking at higher levels and that teachers put too much emphasis on what he called memory questions (i.e. ques-

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[8] Sanders uses the word "question" to cover any intellectual exercises which require a response.

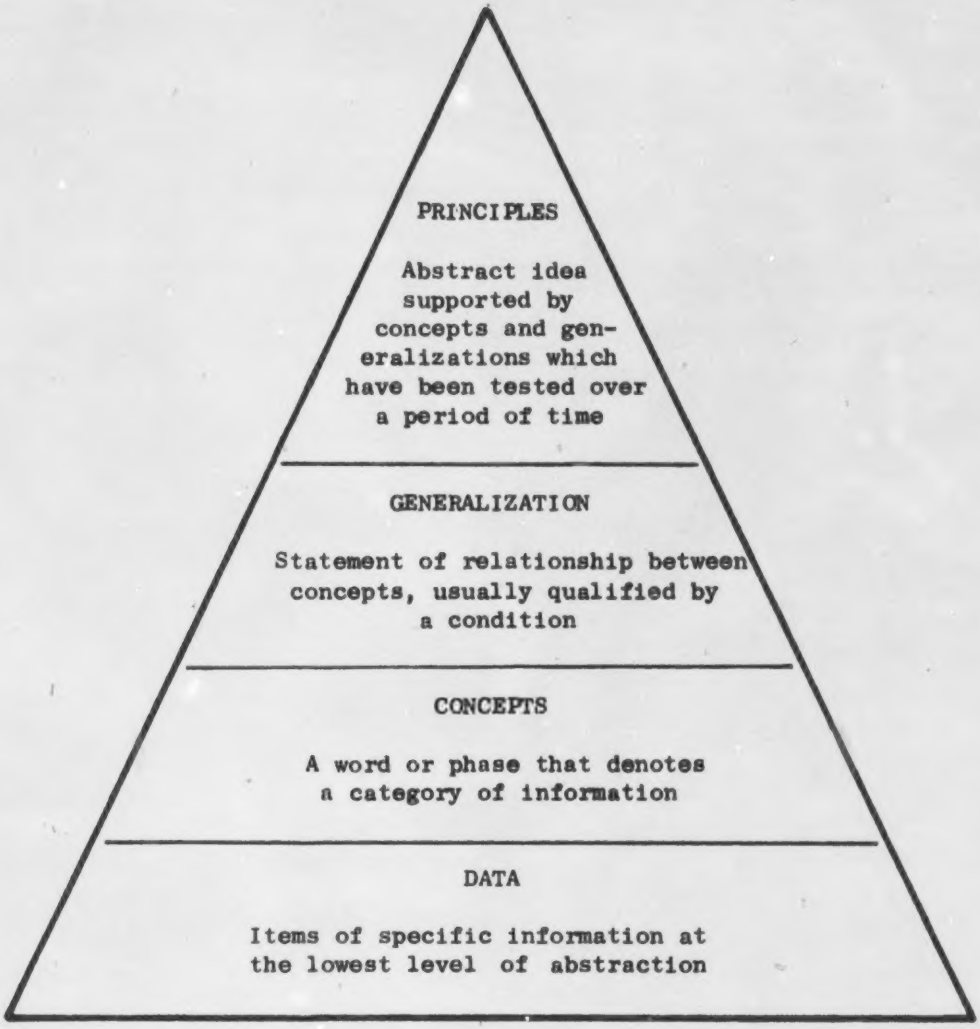
PRINCIPLES
Abstract idea supported by concepts and generalizations which have been tested over a period of time
GENERALIZATION
Statement of relationship between concepts, usually qualified by a condition
CONCEPTS
A word or phase that denotes a category of information
DATA
Items of specific information at the lowest level of abstraction

Figure 2-1

McCollum and Davis's Structure of Knowledge*

*After McCollum and Davis (1972)

tions asking students to recall previously given information). He adapted the taxonomy developed by Bloom and others, as a basis for a questioning strategy, using categories to describe the mental processes the student had to perform in answering the question. In doing so he changed the knowledge category to memory and dropped the comprehension category, using two of the three subcategories in it (translation and interpretation -- see figure 2-2).

Based on the work of Bloom, et. al., Sanders, McCollum and Davis (1972) developed their own process structures (figure 2-2).

The interpretation-of-data/application steps that McCollum and Davis use to relate knowledge and process are essentially the same as Taba's. In interpretation-of-data, data is collected or recalled (if it is provided by the teachers), specific aspects of it are analyzed, relationships explored, and generalizations made on the basis of the foregoing (figure 2-3). Application stages follow a similar pattern (figure 2-4).

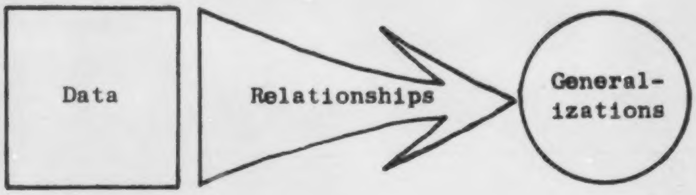

Figure 2-3
Interpretations of Data Process
(McCollum and Davis)

Generalizations are applied by the learner(s) to a different situation to make predictions, inferences, or hypotheses. Learners may be asked for supporting evidence or justification. These are examined in terms

Making a judgment of good or bad, right or wrong according to standards the students develops.	EVALUATION	Making judgments using explicit or implicit criteria.
Solving a problem that requires original creative thinking.	SYNTHESIS	Putting together elements or parts to form a whole.
Solving a problem in light of conscious knowledge of the parts and forms of thinking.	ANALYSIS	Detecting the relationship of parts and how they are arranged.
Solving a lifelike problem that requires the identification of an issue and the selection and use of appropriate generalizations and skills.	APPLICATION	Making logical application of known data to a new situation (transfer of learning).
Discovering relationships among facts, generalizations, definitions, values.	INTERPRETATION	Examining relationships and generalizing from known data (Relating and Generalizing level).
Changing information into a different form or language.	TRANSLATION	Translating knowledge into a parallel form.
Recall or recognition of information	MEMORY	Recall or recognition of information.
Sanders (1966)		McCollum and Davis (1972)

Figure 2-2
Structure of Processes

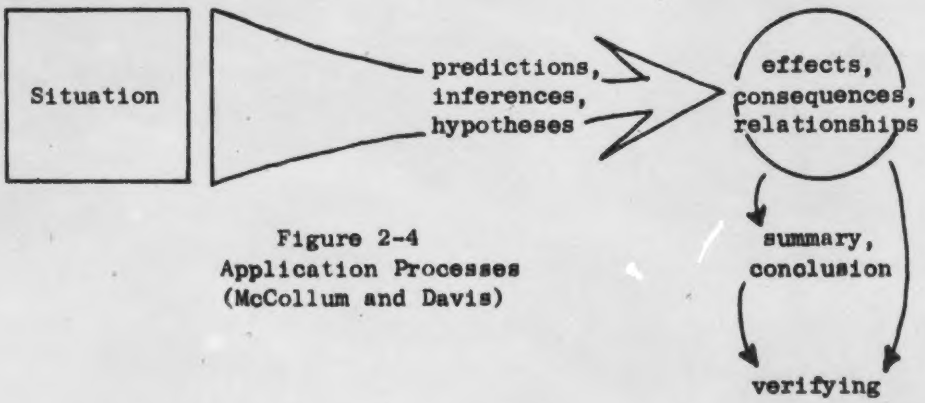
Situation
predictions,
inferences,
hypotheses
effects,
consequences,
relationships
summary,
conclusion
verifying

Figure 2-4
Application Processes
(McCollum and Davis)

of consequences, effects, and/or relationships. If appropriate, what has been explored is summarized or conclusions are drawn. Finally, if possible, predictions, inferences, and/or hypotheses are verified by the students. As a result, the learner travels up a "spiral" (figure 2-5) of increasingly complex thought processes. The overall goal of this process is the creation of an autonomous learner, one that can function independently in the learning process.

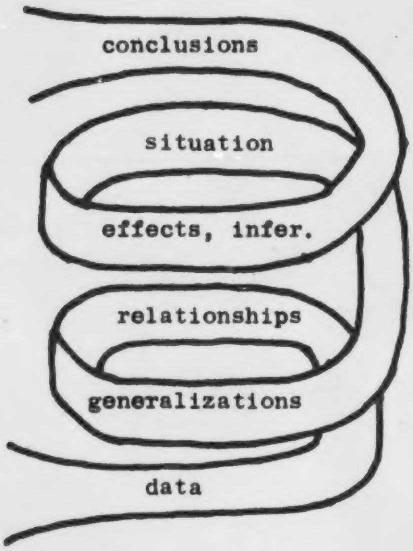
conclusions
situation
effects, infer.
relationships
generalizations
data

Figure 2-5
Interpretation of Data/Application
"Spiral"

Neither Taba's nor McCollum and Davis's instructional model attempts to, at least formally, take the student beyond the application level. Perhaps Taba felt such operations (e.g. synthesis, analysis) were beyond the elementary school children with whom she worked or the processes would occur in the course of application. These however, are speculations. McCollum and Davis (1972) commented "while the higher levels of thinking processes -- analysis, synthesis, and evaluation -- may be provided for, and do occur within the context of this instructional model, specific attention is given primarily to the memory, translation, interpretation, and application levels." They do not elaborate as to why.

Both Taba's and McCollum and Davis's approaches were used in a social studies curriculum. Joyce and Weil (1972) point out that Taba's method is not restricted to that field but could be applied to many other curricular areas. McCollum and Davis's approach should be equally applicable, since it is based on Taba's. This is what McDonald et. al. (personal communication) did, adapting the interpretation-of-data/ application processes for environmental investigations.

The process approach, as conceived by McDonald and McDonald (1977), and defined by Carroll (1975), involves the same sequence as Taba (1966) and McCollum and Davis (1972) use for interpretation of data (data → relationships → generalizations) and application (situation → predictions, hypotheses, effects → conclusion, summary). Although called an interpretation-of-data process by McDonald and McDonald (1977), it commonly goes beyond that (as defined by McCollum and Davis) into elements of application (see section 2.3) For this reason, the process approach has been and is referred to in this thesis as an interpretation-of-data/application process.

The investigative process as presented in the Forest Service workshop approach program is one of interpretation-of-data/application based on earlier work by Taba (1966) and McCollum and Davis (1972). The steps involved are sequential and the underlying assumptions are: (1) There is a hierarchy of knowledge, (2) There is a hierarchy of thinking processes, (3) There is a relationship between the two, and (4) Learning experiences should be structured so as to take into consideration this relationship.

2.3 The Questioning/Task Card Strategy

The questioning/task card strategy used in the process approach is the "vehicle" for the interpretation-of-data/application process. The four categories of questions/task cards are sequential, moving from open to summary respectively, and providing opportunities to collect (open) and look at specific aspects of data (focus), interpret it (focus, interpretive) and summarize and/or verbalize generalizations (summary). Questions and/or tasks involving application are used in summarizing or extending the scope of investigations, but no specific structure per se is defined for the application process. However, McCollum and Davis's structure for application is virtually the same as for interpretation of data (see below). Therefore, one could use the questioning/task card structure identified for application as well as interpretation of data.

While categories have been defined, questions or tasks do not necessarily fall neatly into one of them. They may fall between or take in two or more categories depending on the needs involved. Finally although it can be, the sequence does not necessarily have to be made up of all questions or tasks. A mixture of both can be used -- an investigation may begin with an open question and move to a focusing task, etc.

As with the investigative process, the questioning/task card strategy has its roots in both Taba (1966) and McCollum and Davis (1972). Taba used "eliciting questions" to get students involved in performing the cognitive processes she desired them to try. For example, if she wanted them to verbalize inferences and/or generalizations, she would ask something like: "What does this mean?, What would you conclude?, What generalizations would you make?" Taba regarded the proper strategy of questioning as crucial to development of the desired cognitive skills. Furthermore, the open-ended nature of the eliciting questions provided students with the opportunity to respond on different levels of abstraction and depth or express different perspectives.

McCollum and Davis (1972) adopted Taba's idea of using questions to take students through concepts, interpretation of data, and application. However, their questioning strategy is much more formalized and is the immediate predecessor of the one used in the process approach. In the interpretation-of-data sequence, McCollum and Davis identified four categories of questions: Open-memory, Focusing memory, Interpretation, and Inclusive-generalization. These serve the same purpose as those in the Process Approach (see table 2-2). The application process

Table 2-2
Question/Task Card Categories*

Question/Task Card Category	Description	Example Question
1. Open	Designed to provide an opportunity for all persons to participate and obtain a body of data upon which to focus.	What did you notice about the stream?
2. Focus	Designed to focus thought on specific data that will later be compared/contrasted to other data later in the discussion.	What were some of the plants you listed?
3. Interpretive	Designed to compare, contrast, and seek logical relationships between specific points brought out in the focus question. The learner is asked to express an inferred relationship based on observations.	How might the plants you observed affect the stream?
4. Summary	Designed to obtain conclusion, summary, closure, Calls for a generalization that may be applied to a variety of situations. No new data is introduced here.	Based on your observations and discussions, what can be said about the affect of plants on streams?

*After McDonald, et. al., 1975

questioning structure follows the same pattern: open, focus-application, relating-analysis, and inclusive-interpretation.

Both Taba's and McCollum and Davis's methods are questioning strategies.[9] To put more emphasis on student involvement and participation, McDonald, et. al. (personal communication) applied the questioning sequence of McCollum and Davis (1972) to task cards.[10] Like the open-ended questions Taba used, the task cards allowed people with different levels of ability to participate at the same time. They also: (1) promote small group interaction and data collection and recording (2) allow for individualized study, and (3) put more responsibility for learning on the participant (McDonald, unpublished). One might argue the latter saying that the task cards merely represent an extension of the instructor and so allow no more responsibility than verbal questions. However, by just getting away from the instructor's physical presence and direct interaction with him forces more reliance on the individual and the group of which he is a part. Furthermore, use of task cards allow much greater opportunity for interaction with and exposure to one's environment, an important step toward greater awareness as well as greater knowledge. The use of task cards and questions represents a major modification of previous methods.

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[9] Taba noted more was involved than just good questions. Although she never elaborated formalized discussion management skills as McCollum and Davis (1972) did later, she did comment that discussion skills were employed by teachers in addition to the questioning strategy.

[10] Task cards are cards with an activity or activities printed on them for learner use.

As with the investigative process, the questioning/task card strategy used in the Forest Service process approach is drawn from the interpretation of data/application questioning strategy developed by McCollum and Davis (1972) and, to a lesser extent, Taba (1966). The use of task cards with the same open-focus-interpretive-summary structure is an improvement, putting more emphasis on the learner and increasing contact with the environment. The combination of task cards and questions provide the structure, the "vehicle" for the investigative process.

2.4 Discussion Skills

Discussion skills have two purposes: (1) promoting participation, and (2) helping contribute to the completeness relevancy of the discussion (McDonald, et. al. 1975). They are the key to the instructor's role in facilitating the learning process rather than dictating it. Tables 2-3 and 2-4 are summaries of the discussion skills used.

The skills in table 2-3 are extremely important in creating an open, accepting atmosphere. By accepting responses non-judgmentally supporting and encouraging individuals, and handling errors carefully, the instructor can begin to step out of an authoritarian, knowledge-dispenser role where discussion is primarily one way (student ⟶ instructor) and step toward transferring the learning responsibility to the group and individual by promoting a three way exchange:

Table 2-3 *
Discussion Skills that Promote Peoples' Participation and Contribution

DISCUSSION SKILL	PURPOSE	EXAMPLES OF FACILITATOR'S USE
Acceptance	-Promote participation -Made people feel all responses are acceptable -Feel as worthwhile member of group	"Thank you Bill for your contribution." "Alright Sue. Any other ideas." Nod head in acceptance of response
Supporting	-Helps support person having problems expressing themselves -Feel as worthwhile member of group -Supports people whose every comment is attached by some one. -Supports people who offer irrelevant information on first attempt.	"Let John tell it his way." "Take a minute to think about it." "Your comment relates to what John said." "Go ahead express it anyway you can."
Encouraging	-Encourage those people who are reluctant to say anything to contribute to the discussion. -Feel as worthwhile member of group -Develop feeling or climate that each person can contribute thoughts and ideas.	"Does any one have anything to add?" "I'd like to hear from some of you who haven't said anything yet." "Any more ideas?" "Has everyone had a chance to say what he thinks?"
Handling Errors	-This is a delicate and important skill. If used properly can help the group grow in understanding without embarrasment to anyone. -To avoid embarrassing participants so that participation will not dry up. -Support the participation but not the incorrect answer. -Getting wrong responses out in the open in a positive way so they can be corrected.	"Would you explain what you just said." "How do the rest of you feel about that?" "Maybe you could write that down and find out more about it later." "Are there any other points of view?" "Thank you John - what kind of information would we need to check out your theory?"

*After McDonald, et. al (undated)

Table 2-4 *
Discussion Skills that Contribute to the Completeness and Relevancy
of the Subject Being Discussed

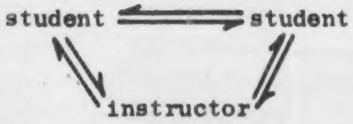
DISCUSS SKILL	PURPOSE	EXAMPLES OF FACILITOR'S USE
Extending	-Obtaining as much information as possible about the subject being discussed. This might be looking for explainations, additions, alternates, etc.	"Is there any thing else you would like to add." "Are there any other ideas." "What else can we say about ---."
Clarifying Content	-Asking for explanations of statements -Tell meaning of unfamiliar terms or fuzzy statements. -Helps rest of group understand	"Can you give us an example of what you just said." "What do you mean by ---?" "Can you say that in another way." "Can some one help with another definition?"
Focus	-Designed to zero in on specific points of discussion	"Which items could be grouped together?" "What do you notice about ----?"
Refocus	-Designed to bring people back to the topic after getting sidetracked. -Maintaining the discussion	"Now - What were we discussing a minute ago." "Lets get back to our topic for now and come back to that later." "How does that relate to the topic?"
Lifting	-Designed to raise the level of the discussion by putting thoughts together into interpretations that may lead to inferences, generalizations or conclusions -Pursues the "whys" with persons on the verge of discovering conclusions, etc.	"How do you account for ----?" "What are some possible reasons for --?" "What can we say about land use in general based on our discussion." "Why do you think ----?"
Time to Think	-Allows people to think. Thinking processes are sometimes slow and painful and takes time to put thoughts together to answer questions. -Long answer periods produce whole sentences evaluative thinking, more responses, increased group interaction. -Long answer periods allows facilitator to vary kinds of questions to ask. -Long answer periods allows facilitator opportunities to hear, think; and more flexibility to meet needs of group and individuals.	Wait for a response after asking a question, support a person though he's silent - repeat question - wait. Don't break the silence by asking another question, someone has to say something sooner than you.
Summarizing	-Summarizing a discussion point -Having someone restate a lengthy observation into several words	"[illegible] you restate that into 3-4 words." "[illegible] can we put what you have just stated on the board?"

*After McDonald, et. al., undated

Table 2-5*
Poor Discussion Habits

TECHNIQUE	EXAMPLE OF USE	IMPLICATIONS	HOW TO CORRECT
Polly Parrot	Instructor repeats each response from each person. Ex.: What did you see? a hawk. A hawk, what else? a dove. A dove, what else? a deer. A deer, any others?	-No one listens to anyone but the instructor, because the group knows the instructor will repeat everything -No one has to speak up loud in the group, because he only needs to speak to the leader -restricts group interaction -the group becomes mumblers	-Recognize you are one - many people don't -Tape your presentation, listen to yourself. -Ask a person to repeat his response so everyone can hear. -Accept response and don't say anything, give non verbal acceptance. -Throwing it back to the group prevents discussion from being leader-centered.
Rewards	Giving one person rewards and not another. Ex.: Excellent answer Bill! Ok Sue, others?	-Playing favorites -Rewards for the best answers -Some answers are better than others -Participants seek rewards instead of thinking through a problem. -More errors in responses when people seed rewards instead of completing tasks	-Reward the person and not his response ex.: "Thank you Bill for participating." -Most effective rewards are an implied acceptance and support for the person not his ideas. -If a person gives an incorrect response you might say "Thank you John, what type of information would we need to check out your theory?"
Tone of Expression	-A know it all voice -Anger in voice -Disgusted or dejected tone -Sarcasm	-Dry up participation -Inhibit people from contributing	-A tone that shows support, encouragement -smiling face -friendly non-verbal appearance -warm tone of expression
Leading Questions	-"It would be a good idea to pave that street, wouldn't it?" -"Of course, the best way to do it is to walk to work right? -"What important things does the film show us?"	-Suggests how the leader wants the group to answer. -Can reveal the leaders own value system -Restricts participation -Leader can't trust answers because he has already suggested the answer.	-Don't impose values on group -Keep questions open to promote an exchange of group values and beliefs
Loaded Question	-"Have you stopped throwing the garbage?"	-The groups is trapped - they are caught no matter how they answer -Restricts participation	-Keep questions open -Don't act as an inquisitor
No time to think	-Ask question, short pause, ask another question.	-Restricts participation -Short answer time gives short answer, no time for evaluative thinking -Short answer time produces memory answers instead of thought answer.	-See time to think discussion skill
Multiple Questions	-Who was the person with the most feelings in the Story? What one had the most interesting experiences? Which one do you think was the oldest?	-People become confused - they don't know which question to ask -Instructor changes focus of discussion	-Ask one question at a time -Write down the question ahead of time and read - don't try to paraphase. -Analyze questions ahead of time - Will they get the responses you want?

*After McDonald, et. al., undated



Here the instructor may be a resource but, whenever possible, avoids being a judge. The overall goal of these discussion skills is to maximize individual participation. This is particularly important since the process approach often relies on group discussion to derive generalizations and relationships.

Because the process approach does rely on group discussion, some form of discussion management is needed. However, it must be done in such a manner as not to discourage participation. As McCollum and Davis (1972) pointed out, this can be done by directing the inquiry at the statement made by the learner, rather than the learner himself. Table 2-4 identifies those skills concerned with managing the substance of the discussion.

McDonald et. al. (1975) go one step farther than their predecessors. In addition to identifying desirable discussion skills, they identify poor discussion habits as well. These are listed in table 2-5. Use of such habits, according to McDonald et. al. (1975), can reduce the group to the "guess what's on the instructor's mind" game and dry up vital group participation and discussion.

In summary, the discussion skills identified in the process approach workshop materials are used to both manage the discussion and create an atmosphere that encourages learner participation. While the investigative process and questioning/task card strategy are the keys to structuring the learning experience, the discussion skills are the keys to the facilitator role. Careful use can make the difference between a poor and excellent learning experience.

2.5 Group Dynamics

Because both individual and group activities are integral to the process approach, an awareness of relevant group dynamics is helpful. This is one of the reasons activities concerning aspects of it are included in the workshop program and why it is briefly touched on here.

The material in the workshop program has been taken from project work for the U.S. Department of Health, Education, and Welfare by Giammatteo and others (Giammatteo, personal communication). The project concerned working with minority/disadvantaged groups (e.g., Native Americans, inner city people, etc.) to accomplish several things: (1) Hear other's points of view without reacting hostilely, (2) Identify, classify and determine the importance of concerns within training groups, (3) Provide skills so minority/disadvantaged participants could perform the same procedure with people in their area to insure that concerns identified by the initial group are shared by the area people in general, and (4) Provide action skills to resolve the concerns identified. The process used to reach these goals involved ideas and activities relevant to the process approach and so applicable to the workshop program. Those that are particularly useful for people employing group-oriented learning experiences include roles played in a group, group arrangement, and stages of group growth.

Giammatteo (undated) identified productive and non-productive roles played by people in groups. Such identification increases awareness of group interactions in the instructor and serve as a starting point from which one can develop a strategy for dealing with non-productive roles. Group arrangement involves the relationship between the physical form a group takes when meeting and participation and communication. Giammatteo felt that the common group arrangement of a speaker facing an audience lined row upon row (as in an average classroom) inhibited a free flow of discussion. Such an arrangement implied that all communication had to go through the person at the front of the room. He offered several alternative arrangements designed to encourage discussion among group members. Such arrangements are particularly useful in an instructional methodology (such as the process approach) in which group discussion is an important factor. Finally, understanding group development stages gives an individual a feeling for what processes a group goes through in attacking a problem as a group.

Group dynamics, like discussion skills, play a supporting role in the process approach. Awareness and knowledge of such things as group arrangement, productive and non-productive roles, and stages of group growth can aid an instructor in planning and carrying out environmental investigations.

2.6 Goals and Objectives

The above has been an analysis of the structure and components of the process approach. A question that remains is -- What can be accomplished by using such a method? Because the process approach has not been rigorously evaluated (McDonald, personal communication) no direct proof exists as to exactly what it can or cannot do. However, indications of potential can be found in the goals/objectives of antecedent methods, the workshop program, process approach characteristics, and the knowledge/process structure on which it is based.

Since the process approach does stress the use of thinking processes, it would be reasonable to assume that, with enough exposure, a student would acquire and be able to use those processes. This is supported by the work of Taba (1966) and the use by McCollum and Davis (1972) of essentially the same technique to meet process objectives. In addition, the objectives defined for the lesson plans used as examples of the application of the process approach reflect what the developers think can be accomplished using it. These objectives describe the use of thinking processes.

Processes cannot be carried out in a vaccuum. They need knowledge on which to operate, either as grist or goals (Bloom et. al., 1956). In addition, the process approach, like its forerunners, is a strategy based on a relationship between knowledge and process structures.

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Knowledge is inextricably tied with process, making it possible to accomplish knowledge as well as process-oriented objectives (Taba, 1966).

Cognitive orientation does not rule out meeting affective goals such as those concerning awareness or attitudes. In fact, both may be accomplished simultaneously (Krathwhol et. al., 1964). Since the process approach emphasizes learner involvement in investigating some aspect of the environment that is in some way unfamiliar to them, the opportunity arises for increased awareness not only on the part of the learner, but the instructor as well (depending on his level of understanding of the topic). In fact, awareness objectives are included in the environmental field investigation lesson plans used in the workshop. Furthermore, depending on the learners existing attitudes, the same factors that brought increased awareness (discovery of new information, relationships, insights) could create or change attitudes.

Research concerning another instructional method which stresses direct learner involvement -- simulation gaming -- indicates that it is superior to more traditional, less involving classroom methods in affecting attitudes. Based on this, direct learner involvement rather than presenting information through some passive intermediate source (textbook, lecture, etc.) may be a good strategy to use in meeting attitude-oriented objectives.

The workshop program is conducted using the process approach so one would expect the goals of the workshops to give an indication of its potential. To this end, the eight regional heads of the Forest Service EE programs were contacted, along with three other people involved in the program,[11] by telephone and asked to identify the primary goals of the workshop program as they saw them. The results are given in table 2-6.

Table 2-6
Workshop Goals as Perceived by Forest
Service EE Personnel

Goal	Number of Respondents That Identified The Goal
1. Increase Awareness of:	
EE	3
Other	7
2. Develop Process Skills in:	
themselves (i.e. participants)	10
Others	10
3. Establish/Improve Communication (between participants)	2
4. Improve Public Involvement Skills	2
5. Impart knowledge	2
6. Enhance Forest Service Image	1

---

[11] Mr. Tom Ellis, Information and Education, State and Private Forestry Region 9; Mr. Ron Greenwald, former National EE Program Coordinator; Ms. Jane Westenberger, Director, Office of Information, Region 5.

Every respondent identified the development of process skills as a workshop goal. A majority (6) also listed awareness goals. However, relatively few identified knowledge oriented goals. This is probably a reflection of the emphasis placed in the workshops on the acquisition of process skills and not an inability of the process approach to meet knowledge-oriented goals.

Just what the process approach can and cannot do has not been clearly established. Yet its characteristics and structure, and the goals/objectives of both other instructional strategies from which it was derived and the workshop program indicate the potential for meeting objectives in the areas of process, knowledge, awareness, and attitudes.

2.7 Weaknesses

One of the biggest weaknesses of the process approach is time consumption. This, however, is the nature of the beast. Telling people that there is enough water in a pond to support 20,000 people for a year is much easier and quicker than letting them figure it out. Whenever active learner involvement is concerned, time becomes a consideration and lack of time may cause some instructors to select more convenient strategies.

Another weakness concerns the management role required of the instructor. A management role may be unfamiliar to many instructors and could inhibit them from trying the strategy. A similar problem has been noted with simulation gaming (Zuckerman and Horn, 1972). Furthermore, the students as well as the instructor may be unfamiliar with an instructor management role. A change to a strategy with which they are not accustomed, particularly one that places more responsibility on them, could result in some confusion and disenchantment on the part of the student.

Related to the problem of management is the need to keep process and content balanced while using any process approach. Leaning too heavily on process could allow errors to be overlooked or go uncorrected. To much emphasis on content, on the other hand, could mask or even eliminate the processes involved for the learner. Either way, the learning experience would suffer.

2.8 Summary

The process approach is an instructional methodology designed to actively involve learners in exploring the environment through the use of problem-solving situations. The traditional authoritarian, judgmental role of the instructor is exchanged for a management one in which the instructor facilitates the learning experience rather than dictating it.

While the investigative process per se is one of interpretation of data/application, the process approach includes a questioning strategy to structure the investigative process, and the use of discussion skills and group dynamics to help the instructor emphasize the role of the learner. The first three of these components are derived from work by Taba (1966) and McCollum and Davis (1972) while the group dynamics material comes primarily from Giammatteo (McDonald, personal communication; Giammatteo, undated).

Because the process approach blends both cognitive process and knowledge, it has the potential for accomplishing objectives in both areas. Awareness and attitude-oriented objectives are also possible since learners are actively involved with and are directly exposed to aspects of the environment. Finally, learners can obtain experience in communicating and working together through the use of groups activities. However, because the process approach is oriented toward allowing learners to work out problems themselves, it is more time consuming than more lecture inclined methods. Another disadvantage lies in the stress placed on the management role. Some instructors may be unwilling -- or unable -- to make such a shift.

There is no "magic" educational method that works for every learning situation. Clayton and Rosenbloom (1968) point out "it has become evident....that the diversity of students and teachers demands a diversity of materials and methods....Not all children will learn equally well, or not at all from the same experience, and not all teachers can teach effectively in a single mold." The process approach is no exception, but where an active, learner-centered experience is desired, one that involves cooperation between the instructor and the learner, the process approach certainly should be considered.

Chapter 3

Fire, Environment, and Man

> "...fire may be the most important single factor in determing what animal and vegetable life will thrive in many areas."
>
> Herbert L. Stoddard, 1931

3.1 Introduction

Fires have been occurring naturally for millions of years. Evidence of their occurrence (fusain or fossil charcoal) is found in coal beds formed during the carboniferous period -- 400 million years ago (Komarek, 1972). Little is known or probably will be known about how these fires fit into the ecological framework of the carboniferous and other past geologic periods. Fortunately however, much more is known about fire and its relationship with ecosystems in which it occurs today. Relatively recent research has shown fire to be a natural component in the functioning of many ecosystems (Kilgore 1972; Biswell 1972; Wright and Heinselman 1973; Habeck and Mutch 1973; Vogel 1977). Within such systems, fire serves as a feedback mechanism whose frequency and behavior occurs in response to environmental cues (climate, weather, vegetation, soil, topography, etc.). In turn, fire influences environment, producing or setting in motion changes that strongly affect or even determine biotic community development and temporarily alter soil and water components. The result of these interactions is a dynamic system -- a system that both affects and is affected by man wherever he has come in contact with it. The following discussion will look at fire-environment relationships in more detail, then examine man-fire interactions.

3.2 Environmental Influences on Fire[12]

3.2.1 Introduction

The three major environmental influences[12] -- fuel, weather, and topography -- exert both direct and indirect influences on fire. Together they determine the likelihood of a fire occurring and its behavior.

3.2.2 Fuel Factors

Fuel factors are the dominant direct influence. These include fuel moisture, temperature, compaction, amount, continuity, and arrangement. A decrease in fuel moisture, or the water content of the fuel, increases the ease of ignition, intensity of the fire, and the rate at which the fire spreads. An increase in fuel temperature also increases ease of ignition and rate of spread both directly, because less energy is needed to start fuels burning, and indirectly, as increasing fuel temperatures mean dryer fuel. The more *compact* a fuel is, the less air is available for combustion, reducing the rate of spread and making the fuel harder to ignite. The latter is one reason why fires usually start in the tinder-like small fuels (needles, leaves, small twigs, etc.). However, even these can be difficult to start. For example, in preparation for a test run of soil nutrients task (lesson plan B), red spruce needle litter was oven dried for 24 hours. Even when extremely dry, it would not carry a flame despite repeated attempts to start it with matches and a butane torch. The small size and short needle length allowed the litter to compact easily, inhibiting combustion (other factors may also have been at work; a fungal mat pervaded part of the litter which although dry, may have inhibited combustion). The intensity can also be affected by the *amount of fuel* -- the more fuel, the greater the intensity, particularly if larger fuels (logs, branches, etc.) are supported by large amounts of smaller ones. This leads into fuel arrangement -- how fuels are mixed in the vertical dimension. Fuel arrangement can greatly affect fire intensity. Note the change in behavior of a fire observed by John Muir (1901) in the Sierra Nevada mountains:

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[12] Fire as used here refers to forest, brush, or grassland fires.

[13] Since all fires produce some kind of updraft, they also influence their own behavior (albeit most of the time in a small way). However, if the fire is intense enough, an extremely strong updraft (convection column) can develop. Davis (1959) estimates velocities can exceed 70-80 mph. The resulting firestorm transcends normally dominating environmental influences, determing its own behavior as long as enough fuel is present to support the fire. Fires such as these though, are the exception to the rule.

> "The fire came racing up the steep chaparral-covered slopes of the East Fork canyon....in a broad cataract of flames, now bending down low to feed on the green bushes, devouring acres of them at a breath....the lurid flapping surges and the smoke and terrible rushing and roaring hiding all that is gentle and orderly in the work. But as soon as the deep

> forest was reached the ungovernable flood became calm like a torrent entering a lake, creeping and spreading beneath the trees where the ground was level or sloped gently, slowly nibbling the cake of compressed needles and scales with flames an inch high, rising here and there to a foot or two on dry twigs and clumps of small bushes and broome grass."

The deep forest Muir refers to was a very open one consisting of pine and Sequoia with a grass understory. Without taller understory vegetation to carry the fire into the tree crowns,[14] the fire's behavior was radically changed. Another limiting factor involved was fuel continuity -- how fuels are put together in the horizontal dimension. The grass fuels were contiguous, allowing the fire to spread through the understory without much difficulty. The trees however, grew individually in clumps preventing the fire from spreading through the trees even if a group of trees or a single tree caught fire. In general, patchy fuels result in a fire that spreads in fits and bursts, if at all.

3.2.3 Weather Factors

Weather influences fire both directly and indirectly. Direct influences are wind and lightning storms. A headwind can "push" a fire and provide it with more oxygen, increasing rate of spread and intensity. A wind blowing into a fire, however, will slow the rate of spread. Lightning is a major ignition source[15] (and before man the primary cause of fires). For example in 1968 Komareck estimated 2.739 lightning thunderstorms passing over about 275,000 square miles of central United States in a one hour period. This only represented the activity along one front and such fronts repeatedly sweep the North American continent during the summer. Precipitation from storms also puts fires out.

---

[14] Also, if the understory or forest floor fire is hot enough, heat alone can ignite tree crowns.

[15] Other less common natural ignition sources include spontaneous combustion and sparks from rocks (Vogel, 1974).

Wind and storms are also indirect influences, along with relative humidity, temperature, and dew point. Wind can accelerate fuel drying while precipitation from storms or the presence of dew increases fuel moisture. *Air temperature* affects fuel temperature which has been discussed above. *Relative humidity* plays a large role in determining fuel moisture (also discussed above). Smaller fuels adjust the quickest to changes in relative humidity (perhaps a matter of hours) while logs, large branches, and other larger fuels take longer (as much as several days).

3.2.4 Topographic Influences

Topography also exerts both direct and indirect influences through slope, aspect, elevation, and the shape of the land. *Slope* has direct and indirect effects. Up slope fuels are actually closer to the flames and so receive more radiant energy. In addition, hot air from a fire tends to move up slope, preheating and predrying fuels located there. The net result is a faster rate of spread up slope than down. The steeper the slope, the faster the spread. Both *aspect* (the direction a slope faces) and elevation indirectly affect fuel moisture and temperature. A south- or southwest-facing slope receives more sunshine than north facing ones (in the northern hemisphere). Consequently, fuels on the former are warmer and dryer. Also, fuels at higher elevations are cooler and so retain more moisture. Finally, the shape of the land indirectly affects fire -- narrow canyons and valleys can channel winds which in turn can "push" fires.

There is another dimension to these factors that has not been mentioned -- time. Fuel moisture, relative humidity, wind, temperature, fuel arrangement, type, and continuity change on a daily, monthly, yearly, and longer basis as changes in weather and vegetation occur. Consequently both ignition potential and fire behavior depend on the point in time at which they are considered, giving the system a temporal motion. Furthermore, the factors will also vary over area, particularly if topography varies considerably. Because of this inherent variability, fire behavior not only differs between fires, but within a single fire as well.

3.2.5 Summary

This has been a very brief overview of natural environmental influences on fire. Table 3-1 is a summary of these factors and their relationship to fire. The discussion has been limited to the more immediate factors. These, in turn, are influenced by other environmental factors. For example vegetation, which determines the kind of fuels available is itself determined by climate and soil. Even past

Table 3-1
Summary of Environmental Factors Affecting Fire

Factor	Direct/ Indirect	Related Factors	Comments
Fuel:			
Moisture	direct	relative humidity, temperature, wind, precipitation, aspect, elevation, dew point.	**↑ fuel moisture results in ↓ in ignition potential intensity, rate of spread.**
Temperature	direct	aspect, elevation	**↑ fuel temperature results in ↑ in ignition potential, rate of spread.**
Arrangement	direct	--	**proper combination of fuels can result in intense crown fire.**
Continuity	direct	elevation, aspect	**continuous fuels will ↑ ease of fire spread.**
Compaction	direct	kind of vegetation	**↑ compaction results in ↓ rate of spread, intensity, ignition potential.**
Amount	direct	decomposition rate	**↑ amount results in ↑ fire intensity.**
Weather:			
Wind	direct	shape of land	**↑ wind results in ↑ rate of spread, intensity.**
	indirect	fuel moisture	**↑ wind results in ↓ fuel moisture.**

Table 3-1, Continued.

Factor	Direct/ Indirect	Related Factors	Comments
Precipitation/ storms	direct	--	**lightning in an ignition source**
	direct	---	**puts out fire**
	indirect	fuel moisture	**↑ rain results in ↑ fuel moisture.**
Dew point	indirect	fuel moisture	**dew present, ↑ fuel moisture.**
Relative Humidity	indirect	fuel moisture, dew point	**↑ relative humidity results in ↑ fuel moisture.**
Temperature	indirect	fuel moisture, fuel temperature	**↑ temperature results ↓ fuel moisture, ↑ fuel temperature.**
Topography:			
Slope	direct	--	**↑ slope results in ↑ in rate of spread, intensity.**
Aspect	indirect	fuel moisture, fuel temperature, fuel continuity	**amount of sun received varies with aspect. ↑ sun results in ↑ fuel temperature, ↓ fuel moisture.**
Elevation	indirect	fuel moisture, fuel temperature, continuity.	**↑ elevation results in ↓ in fuel temperature, ↑ fuel moisture.**
Shape of land	indirect	wind	**landforms channel winds, affect air movement.**

fires play a role. In the Sequoia/pine forests of the Sierra Nevada mountains, frequent fires (one roughly every four to twenty years -- Kilgore, 1973) molded the natural community (see section 3.3.3) and prevented fuel build up, curtailing the intensity of future fires. Thus ignition potential and fire behavior are an integral part of and shaped by the functioning of the ecosystem as a whole.

3.3 Fire Influences on the Environment

3.3.1 Introduction

Fire can profoundly influence the biotic community both directly and indirectly. Figure 3-1 is a diagram illustrating a generalized flow of impacts.[16]

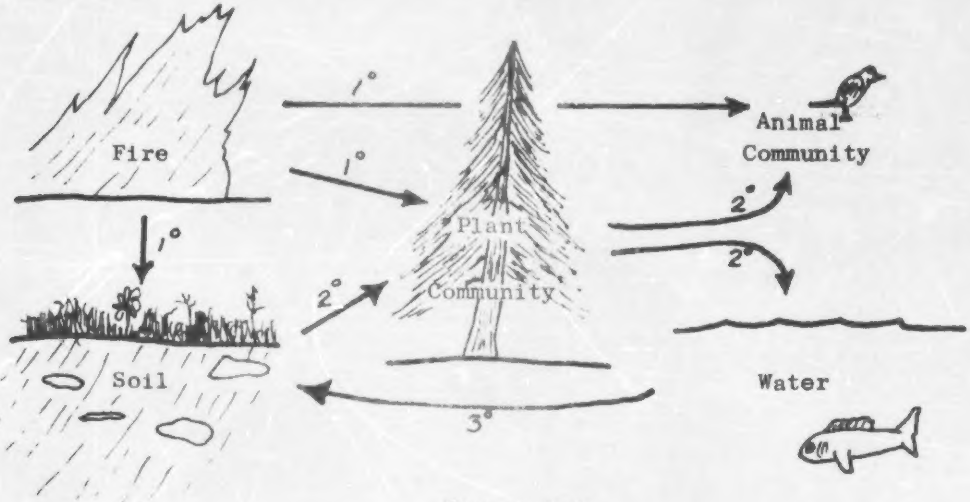

Figure 3-1
Fire Generated Impacts

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[16] The degree of impact varies with intensity and extent of the fire.

Most impacts flow into or out of the plant community, making it the focal point of fire's effects. However, since effects on soil affect plant communities, soil will be considered first.

3.3.2 Fire Effects on Soil

The most obvious effect fire has on soil is the removal of the surface litter layer and, if intense enough, partial or total removal of the duff and even humus layers. In doing so, fire can play an important role as a decomposition agent[17] (Mutch, 1970) in some temperate coniferous forests where the rate of litter production outstrips decomposition by organisms (Olsen, 1963).

Fire also increases surface soil temperature, both during the fire and afterwards, since the black layer of ash left absorbs solar radiation (Ahlgren and Ahlgren, 1960). In addition, removing or reducing the standing vegetation increases the amount of solar radiation reaching the soil, also raising the surface soil temperature.

In burning litter, fire converts previously tied-up nutrients to available forms and leaves them behind in the ashes (some, particularly nitrogen, are volatilized if the fire is intense). The significance of this effect varies. Both Viro (1974) and Christensen and Muller (1975) regarded it as a positive factor, while Old (1969) found nutrient release from ashes had no effect on plant growth in the tall grass prairie community.[18] Initial fertility of the soil may offer some explanation for the conflicting results. Plants growing on soils of borderline fertility (or worse) would benefit the most from fire related nutrient increases. If nutrients were not limiting (or only very slightly so), an increase produced by fire may not be significant.

---

[17] Decomposition and combustion are essentially the same process -- an oxidation reaction with carbon dioxide, water, and energy as the end products.

The increase in nutrients can also increase the pH of the surface soil layer (Ahlgren and Ahlgren, 1960). If the surface layer is acidic (as is coniferous litter and duff), this neutralizing effect could be beneficial to plant establishment and growth. Because these nutrients are water soluable, increases are temporary, ranging from a few months (Haines, 1926) to ten years (Eneroth, 1928).

Vogel (1977) regarded the relationship between fire and soil erosion as misrepresented. He noted that where erosion is associated with natural fires, fire is not the cause per se, but some characteristic inherent in the soil. While it is true that soil erodability depends a great deal on soil characteristics, fire can set the stage for erosion by removing the protective layer of vegetation. Biswell (1974) observed that after one severe chaparral fire in southern California in 1959, debris movement down steep south-facing slopes reached ten times the already high pre-burn rate. Biswell further commented that soil erosion following fire in the chaparral depends on time, amount and intensity of rainfall, percentage of cover removed, steepness of slope, severity of the fire, length of time since the last burn as well as the erodability of the soil. In short, erosion potential after a fire is site and situation specific, something that undoubtedly applies on a general level.

---

[18] She did find burning stimulated growth. She attributed this to decreases in competition from early season grasses and increases in microbial action due to increases in soil temperature.

3.3.3 Fire Effects on Plants

Effects on plants are both direct (injury and kill), and indirect (alteration of environmental conditions). Direct impacts vary widely and can be viewed as falling somewhere on a continuum, depending on the nature of the fire:

highly selective mortality, partial removal of vegetation, community maintenance	virtually total mortality, total removal of vegetation, community replacement.

An example of the left hand side of the continuum is the Giant Sequoia/pine forest of the Sierra Nevada mountains. Typically fires were ground fires of low to medium intensity, occurring in frequencies ranging from four to twenty years (Kilgore, 1973). The low intensity of these fires resulted in selective mortality favoring Giant Sequoia, sugar pine, Jeffrey and ponderosa pine, whose thicker insulating bark gave them better protection from heat. In this way, the frequent fires were in large measure responsible for the species make-up of the plant community.

Such fires also determine the physical appearance of the community.

The above forests were remarkably park-like. King (1871) described an 1864 ascent into the Sierra Nevada as follows:

> "...Passing from the glare of the open country into the dusky forest, one seems to enter a door, and ride into a vast covered hall....You are never tired of gazing down long vistas, where, in stately groups stand tall shafts of pine. Columns they are each with its own characteristic tinting and finish, yet all standing together with the air of relationship and harmony..."

The frequent fires prevented the underbrush from establishing itself, keeping the understory primarily grass. Fuel build-up was also prevented, insuring future fires of low intensity. Forests of a similar nature, but of different species (longleaf and slash pine) once extended from southern Virginia to east Texas (Komarek, 1974).

In plant communities such as the jack pine forests of the central Northwest, major fires occurred much less frequently and were of greater intensity. Typically, such fires occurred only once in the life of a jack pine forest, killing all above ground vegetation (Ahlgren, 1974). However, an unusual adaptation -- serotinous cones[19] (cones sealed with resin and open when heated) -- help insure natural re-stocking with jack pine. Jack pine cones are produced at an unusually early age (about ten years) and held on the tree for as many as twenty years although viability decreases with age (Ahlgren, 1974). Since the interval between fires is longer,[20] a large store of seed accumulates and is released when heat from the fire breaks the resin bond and the cone gradually opens. Thus a cycle of replacement (figure 3-2) rather than maintenance occurs. The result is a plant community whose dominant species are approximately the same age (even-aged), and a landscape that is a mosaic of even-aged communities. Furthermore, depending on how recent the fire was and the species available for restocking, the community could be dominated by herbaceous shrubby, hardwood, or coniferous vegetation or a comination of these if in a transition from one to another, or if pre-burn vegetation was not totally removed.

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[19] Cone serotiny is also found in lodge pole pine of the Rocky Mountains and West (Lotan, 1974), knobcone pine of Southern California (Vogel, 1973), and sand pine of Florida (Komarek, 1971).

[20] Heinselman, 1973, estimated a natural fire rotation of 50 to 100 years for Minnesota jack pine forests.

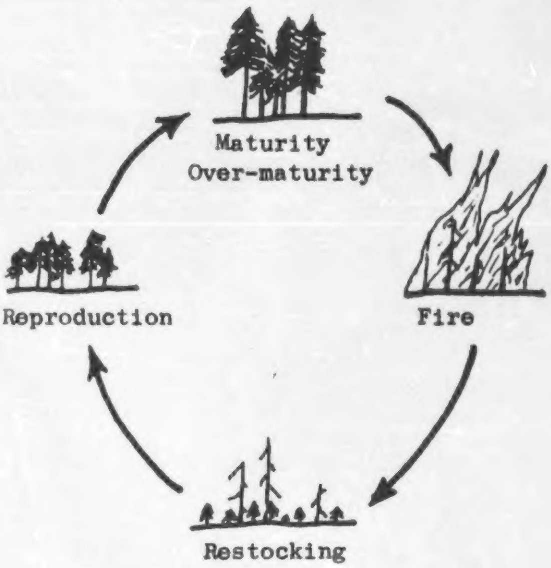

Figure 3-2
Community Replacement Cycle

Fire replacement communities are not confined to tree species with serotinous cones. Weaver (1974) cited observations by Muir (1918) and Isaac (1943) of large areas of even-age west coast Douglas Fir. Each observer concluded, as did Weaver, that the communities were the result of fire removing previous ones.

Between the two extremes there is considerable middle ground. For example, chaparral communities contain elements of both. They are particularly flammable (Biswell, 1974) with a fire frequency ranging from fifteen to forty years (Philpot, unpublished). Fires typically remove all above ground vegetation, but mortality is not widespread due to vigorous sprouting. Seeds are produced at an early age, are heat resistant, and, in most species, can remain dormant for long periods. Because seeds accumulate, seedling densities can be heavy after a fire (Biswell, 1974), so even if some plants fail to sprout, plenty of seedlings are available for replacement.

While the direct effects of fire on plant communities are often immediately apparent, the indirect effects are less so. Yet fire, through its "decomposer role" is a key to successful reproduction. In many conifer communities, the partial or total removal of litter and duff allows seedlings to reach mineral soil -- and vital water -- quickly (Ahlgren and Ahlgren, 1960). Other benefits include decreased competition (Old, 1969; Kilgore, 1973), destruction of fungi (Davidson, 1971) and alleopathic compounds (Christensen and Muller, 1976), changes in surface soil texture (Hartesveldt and Harvey, 1967), the opening up or removal of the overstory allowing more light to reach seedlings (Hartesveldt and Harvey, 1967, Cayford, 1970), and a temporary increase in available nutrients either from ash (Cayford, 1970) or possible increases in microbial action due to increased soil temperature (Old, 1969). Of course, the above list is taken from plant communities in which fire plays a major role. Vogel (1977) has pointed out that some of these effects can produce long term, possibly permanent changes in plant communities in which fire is not a normal component (e.g. tropical forests).

Fire may also control some plant pathogens and encourage others. While fire is used to control brown needle spot disease in longleaf pine, fire scars can also provide entry points for heartrot (Ahlgren, 1974). With some diseases and parasites, periodic fire results in short term control, but long term perpetuation. For example, short term, local control of dwarf mistletoe, a pest of lodgepole pine is obtained when fire destroys infected stands. However, in the long run such fires perpetuate lodgepole pine and also the pest (Wicker and Leaphart, 1974). Finally, results reported by Parmeter and Uhrenholdt (1974) indicate smoke may also play a role in controlling a variety of fungi by inhibiting spore germination, mycelial growth, and colonization.

Finally, heat from fire may serve as a mutagen (Komarek, 1965); Howe, 1974). Howe adds that fire could also serve as an agent of genetic drift by leaving small clumps of trees isolated from other pollen sources. The small size of these groups would accentuate the effects of genetic drift within them.

3.3.4 Fire Effects on Wildlife

As with plants, fire affects wildlife both directly and indirectly. The Smokey Bear "crispy critter" propaganda and other media events (e.g. Bambi) reflected the past assumption that fire is very destructive of wildlife. No such generalization can be made. In fact, wildlife mortality from most fires is minimal (Komarek, 1969; Vogel, 1973). Animals move out or take refuge in burrows or even under rocks. However, an unusually hot and/or fast moving fire might overtake runners and/or suffocate or overheat burrowers (Handley, 1969). In any fire, those most affected are ones whose mobility is restricted in some way, either physically (e.g. injured, young, slow-moving) or behaviorally (e.g. presence of young or nest, strong affinity for home range). For example, fire is particularly destructive of spiders and mesofauna (mites and springtails) because of their limited mobility and surface dwelling habits (Ahlgren, 1974. See table 3-3 for a summary of fire's effects on some soil wildlife).

A fire-induced animal stampede is another popular idea (e.g. Bambi) that has been exploded by the observation of calm animal behavior during fires (Hakala, et. al., 1971; Komarek, 1969, and Vogel, 1973). In fact, reports of panicky animal behavior during fires could be due to the presence and activity of men fighting the fire rather than the fire itself (Komarek 1969; Leopold 1923).

The majority of impacts on wildlife occur indirectly. The diversity and complexity of ecosystems are such that impacts can take many different routes and be transmitted through a variety of components. The discussion here will center around cover-, food-, and water-related effects on wildlife.

Wildlife use plant cover to meet reproduction needs, escape, aid in predation, and as shelter from the elements (Smith, 1974). The

Table 3-2
Fire Effects on Some Soil Wildlife
(After Ahlgren, 1974)

Organism	Influence	Direct (fire kill)	Indirect (change environment)	Comments
Bacteria	variable	2*	1	studies reviewed show variety of results. However, ↑ pH after burning would favor bacteria. Also 8 out of 9 studies indicated ↑ in activity of N fixing bacteria after a fire.
Actinomycetes	variable	2	1	more resistant to heat and drying than bacteria.
Earthworms	decrease	2	1	affected more by soil moisture ↓ following fire than by actual heat.
Snails	decrease		not discussed	
Insects	variable	2	1	effect depends on species. Bettles, some grasshoppers ↓, ants ↑. Also initial ↓ can be followed by ↑ as plants regrow.
Spiders	decrease	1	2	surface dwelling habits make them vulnerable.
Mesofauna (Mites and Collembolans)	decrease	1	2	dry conditions following fire are not favorable.
Centipedes & Millipedes	decrease	2	1	

*2 = secondary importance
1 = primary importance
↑ = increase
↓ = decrease

most immediate effect of fire is to force wildlife from cover and expose it to predation. Komarek (1969) has observed a variety of birds and even insects feeding on insects and small mammals flushed by grass fires.

Removal of cover by fire can cause several longer-term effects. Increased competition for the remainder can occur (Keith and Surrendi, 1971) with the losers moving on or taken by predators. Also, if the fire removes both under- and overstory vegetation, microclimate will be affected. Increased temperature has been considered a factor in the decrease of red back vole populations following a clearcut and burn (Gashwiler, 1970). Microclimate changes (dryness, greater temperature fluctuations) have also been cited as important causes of decreases in soil fauna (Ahlgren, 1974). Of course, any microclimate changes would have the greatest impact on wildlife that were in some way restricted to the area concerned. More mobile forms could seek better conditions elsewhere (unless the burned over area was extremely extensive).

Changes in vegetation on burned areas as they move toward pre-burn conditions can produce cover favorable or unfavorable to wildlife depending on the species. The Kirtland Warbler, one of the rarest of the wood warblers, requires dense clumps of young jack pine interspersed with many small grassy openings for nesting habitat (Line, 1964). Naturally, such conditions are produced only by fire. The gradual reinvasion of post-fire shrubfields by conifers, creates a young conifer stand/shrubfield mosaic very favorable for overwintering elk (Martinka, 1974). Conversely, continuous ground cover (such as might be found in younger post-burn sites) is not good for ruffed grouse, because it provides better hunting cover for predators (Gullion, 1976).

The extent and duration of any cover-related effect on wildlife depends on fire behavior and general environmental conditions. In general the more severe the fire, the greater time needed for the site to return to pre-fire cover conditions, and the larger the fire (acreage), the more extensive (area) the cover changes. General environmental conditions also influence cover-related effects by affecting plant growth. Good plant growth conditions would speed return to pre-fire conditions, decreasing the duration of the effects, while poor conditions would do the reverse. Because of the inherent variability of these two factors -- fire behavior and environmental conditions -- the impacts discussed above will vary.

Fire effects on wildlife food sources have been noted in three areas: (1) kind of food, (2) quantity, and (3) quality (Bendell, 1974).

Concerning changes in food sources by fire, Aldo Leopold (1923) wrote: "It is a pretty reliable rule of thumb that fire tends to eliminate the plants useful to game or forest and tends to encourage plants useless to both. Leopold's "rule of thumb" proved incorrect.[21] Changes in kinds of food can be beneficial to some wildlife. For example, shrubfields and young conifers following fire in Glacier National Park are important winter food sources for elk (Martinka, 1974). Rarely, fire results in the appearance of a plant species on which a wildlife species is totally dependent, as in the fire-wild blue lupine-Karner Blue butterfly relationship in the pine bush of upstate New York. In general though, the degree and direction of impact (positive or negative) will depend on the wildlife species and the nature of revegetation.

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[21] Leopold later changed his viewpoint on fire, although Vogel (1967) notes that Leopold had difficulty "overcoming his previous forestry indoctrination."

Fire-induced increases and decreases in food quantity can occur on both short and long term basis. On a short term basis, there is a sudden and brief increase in prey for some predators as small mammals and insects retreat before the flame front (Komarek, 1969).[22] Immediately following a fire, however, there is a lack of plant food sources, which could mean severe competition if the surviving population exceeds the carrying capacity.

The stimulation of plant growth after a fire is well documented (Ahlgren and Ahlgren, 1960; Old, 1969; Wright and Heinselman, 1973; Christensen and Muller, 1976) and means a longer term increase in plant food abundance. This increase can be a factor in population increases. Ahlgren (1966) attributed increases in deer mice populations on revegetating burned areas to an abundance of seeds and insects. New sprouts can also provide new food sources to browsers like deer, moose, and rabbit.

Increases in prey species can provide more food for predators. Barmore et. al. (unpublished) noted that bark beetles, flourishing in fire-killed standing timber, benefited woodpeckers.

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22 This would happen only if the behavior of the fire allowed (1) successful retreat, and (2) predators to approach the flame front.

Decreases in longer term food availability also occur. Scotter (1971) thought fire-related reductions in the standing crop of ground and tree lichens, a winter forage of caribou, reduced the caribou's winter range. Vogel (1974) noted a possible reduction in marginal grassland productivity from burning too frequently or during periods of critical moisture. Reduced productivity could impact wildlife, particularly if extended for several years (Vogel did not discuss possible wildlife impacts).

Increases in plant food quality (greater levels of protein and mineral nutrient content) do occur, possibly in response to greater availability of nutrients, following a fire (Bendell, 1974). However, Bendell goes on to question the significance of such increases. Based on a summary of published data concerning nutrient content of deer foods before and after fire, concluded the changes were "not impressive." He also pointed out that the level of nutrients in plants depended on "season, soil, weather, nature of fuel and fire, and other factors." Given these factors, generalizations concerning wildlife benefits from fire-induced increases in nutrient levels in plants are difficult to make.

There have been scattered reports of fire induced, water-related impacts on wildlife. Leopold (1923) reported a fish kill in a brook following a rain in a severely burned over watershed. He speculated ashes washed into the brook were responsible. Hakala (1971) also noted a fish kill following a large fire in Alaska. A large amount of fire retardent dropped both near the river concerned and its tributaries on the day prior to and of the die-off may have been partially responsible, although Hakala makes no overt connection. The possibility remains, however, that large scale fires may adversely water wildlife via changes in water quality.

Other effects include:

1. Increase in stream temperature caused by removal of streamside vegetation (Helvey, et. al., 1974), which could affect stream wildlife. Impact would depend on pre-fire stream characteristics, aspect, amount of post-fire sunny weather, etc.
2. Increase in sedimentation (Anderson, 1974) caused by erosion. Amount would depend on factors influencing erosion (see page 59). Large amounts could smother fish eggs and some bottom-dwelling stream life.
3. Increase in areas of open water and edge in dense marsh vegetation, benefiting some marsh wildlife (Ward, 1968).

Water related impacts are also possible on terrestrial wildlife. Bendell (1974) observed blue grouse leaving an area two months ahead of normal migration time, despite an apparent abundance of food supply. Bendell thought a shortage of water brought about by fire-induced changes in microclimate was the cause. The significance of this effect may depend on the animal's mobility, precipitation, and the presence or absence of surface water.

In Alaska, if the insulating layer of vegetation is thinned or removed by fire, the permafrost beneath begins to melt. Ponds can be formed, which may increase their size by melting permafrost at their edges (Viereck, 1973). The increase in standing water could improve or generate habitat for aquatic animals and increase water availability for others.

Water-related impacts on wildlife vary with fire behavior, but it appears the fire has to be fairly severe (removing most of the standing vegetation and litter and/or duff), before the effects are felt.

In addition to specific on and off-site impacts, the overall effect of fire on wildlife needs to be examined, encompassing both burned and unburned areas. The characteristic mosaic of various aged plant communities (see page 68) can only result in a greater variety of ecological niches, making possible greater wildlife diversity (in comparison with a forest of continuous coniferous cover over an area of equal size). Thus fire becomes an agent in maintaining a higher overall diversity than might otherwise occur.[23] Furthermore, changes in richness and equitability[24] would constantly be occurring as plant communities changed over time.[25] Although the system may seem static to the casual observer, viewed on a longer term basis, it is constant motion.

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[23] Fire is not unique in this respect. Windthrow, disease, insect outbreaks, avalanches, and rockslides are all environmental forces that can produce the same result.

[24] Richness refers to the number of different species in a community. Equitability refers to the evenness of apportionment of individuals among those species. For example, given a community with 10 species: a distribution of 91 individuals in one species and one individual in the other nine would be a very low equitability. A distribution of ten individuals per species would be a very high equitability.

3.3.5 Fire Effects on Water

Some fire-related impacts on water have already been mentioned -- increases in stream temperatures and sedimentation. Another, evaporation of water from soil surface layers deserves further comment. Increased evaporation does not mean an overall increase in soil water deficit.[26] Klock and Helvey (1976) found soil water deficits decreased the year following a severe wildfire (all above ground vegetation destroyed). The decrease was attributed to removal of the vegetation, drastically cutting losses from transpiration. Two potential impacts resulting from this decrease were identified: (1) acceleration of mass soil movement on steep slopes, and (2) increased streamflow due to increase in available underground runoff. The latter was documented by Helvey et. al. (1976) in another study in the same area, and by Anderson (1976) elsewhere. The increased streamflow caused channel cutting in affected streams (Helvey et. al., 1976), raising the possibility that forest fires that remove all or most standing vegetation in watersheds, may exert considerable influence on channel development. Again, it should be stressed that the effects discussed above are the result of severe fires. Anderson (1976) pointed out fire's impact on water covers a broad spectrum, ranging from the negligible effects of light or spot fires to those mentioned above for larger, more severe ones.

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[25] Bendell (1974) wondered about the magnitude of such changes. In summarizing breeding bird species and population density data from ten before-and-after-fire studies, he did not find "the wholesale adjustment one might expect." He felt this reflected that (1) fire burns unevenly, leaving some prefire habitat, and (2) a tolerance of a wide range of environmental conditions by the species concerned. He also noted the problems inherent in the summary (small sample size and short periods of count). In addition, the categories Bendell used and the studies may have introduced bias. Bird species were categorized as grassland and shrub, tree trunk, or tree canopy oriented, indicating a basic distinction between tree-oriented and grassland or shrub oriented species. But three of the studies were in shrub (2 in chaparral) or grassland (1) dominated areas. Given the categories, a major shift in species would not be expected. Also, in three other studies the tree overstory remained intact, which would tend to reduce the loss of tree oriented species. Thus, six of the ten studies could have biased the results.

[26] Soil water deficit is the difference between maximum soil water retention of the soil ("field capacity") following a period of maximum input (e.g. snowmelt) and the soil water present at the time of measurement.

3.3.6 Fire Effects on Air

The most obvious, immediate, and probably most important air-related impact of fire is the generation of smoke. Possible smoke inhibition of fungi has been mentioned earlier. In extreme cases, smoke has decreased sunlight and delayed ripening of crops (Udvardy, 1969). For the most part, though, impacts from smoke are transitory and probably not significant.

Intense firestorms can generate high velocity winds in their interior and uproot trees (Gorsuch, 1969). However, since the trees are already fire-killed, the impact of uprooting would be limited to possible increases in soil erosion.

3.4 Man-Fire Relationships

Man has only recently gained the skills and knowledge necessary to effectively suppress fire, but he has been starting them for hundreds, even thousands of years. In some areas, including the Northeast, Indians use of fire was responsible for turning what was a minor natural environmental factor into a major one. Thompson and Smith (1970) cite records of early explorers like Morton, who in 1632 wrote of the Massachusetts Bay area:

> "The Salvages are accustomed, to set fire of the Country ....to burne it, twize a year, vixe at the Springe, and the fall of the leafe. The reason that mooves them to doe so, is because it would be otherwise be so overgrowne with underweeds, that it would be all a copice wood, and the people would not be able in any wise to passe through ....this custome of fireing....meanes the trees growe here and there as in our parks; and makes the Country very beautiful and commodious."

Such observations by early travelers in Massachusetts, Connecticut, and Rhode Island led Bromley (1935) to conclude "[o]n one subject all are in accord and that is the observation that the original forest was, in most places, extremely open and park-like, due to the universal factor of fire, fostered by the original inhabitants to facilitate traveling and hunting." Thompson and Smith concluded the Indian's use of fire was an important factor in maintaining a mosaic of different successional stages which in turn was primarily responsible for the abundance of deer, turkey, quail, and heath hen described by early observers.

The white man that displaced the indian also affect fire-environment relationships, but in a different way. The forest was of low value to the settlers who would often fire it to help clear land for farming

(Davis, 1959). Of greater impact, though, were the logging practices in the conifer forests of the east and lake states (and later in the west). Sometimes loggers would burn off waste, which occasionally led to wildfire. More importantly they left a great deal of slash (logging residue) lying on the ground. By the late 1800's, human carelessness combined with dry weather brought a series of unnaturally and extremely severe and extensive fires (Davis, 1959). The best known of these was the 1871 Peshtigo fire which claimed 1,280,000 acres and 1,500 lives, and would have undoubtedly have been better known but for the fact it occurred on the same date as the great Chicago fire. Such fires were out of step with the natural conditions and undoubtedly adversely affected the ecosystems in which they occurred.

These fires had another effect. During the late 1800's and early 1900's the conservation movement in the United States was taking hold in response to the wasteful and destructive practices of preceding years (Udall, 1963). The disasterous fires of the era made the destructive side of fire readily apparent. In the eyes of resource managers fire became an enemy of the forest, and immediate and total suppression of all fires regardless of origin became the rule. As technology and training improved suppression became more effective, and the lack of distinction between man-caused and naturally occurring fires resulted in preventing fire from filling its natural role.

This disruption had and is having a number of impacts. As the selective influences of fire were removed, changes in plant community composition and appearance began to occur (Heinselman, 1971, 1973; Kilgore 1972). Figure 3-3 is an example of the change occurring in Yosemite National Park. The patchwork of different age and development stages of plant communities was also affected. In the Selway-Bitterroot Wilderness of Idaho, Habeck (1974) observed:

> "Fire exclusion policies during the past one-half century have evidently limited the number and assortment of pioneer and early seral stages of forest development....the pristine mosaic that characterized much of the Selway-Bitteroot Wilderness is gradually being lost....percentage of intermediate and old age communities....is increasing and the diversity of life forms is being reduced."

This meant, as had happened earlier in the northeast, a decline in habitat quality for many wildlife species (Heinselman, 1973; Vogel, 1977). Finally, ironically, putting all fires out has actually increased the fire hazard. The removal of fire as a selective and decomposition agent meant a build-up of both living and dead fuel. Kilgore and Sando (1975) point out that the increased number of saplings, particularly white fir (see figure 3-3) has, by providing a "ladder" for fire, created the major threat of crown fires in the Sequoia/mixed conifer forest where it did not exist before. Habeck (1974) noted the decrease in plant community mosaic (see above) reducing fuel discontinuity which, he concluded, was likely to change the behavior of future fires. It isn't hard to imagine how. Overall, continued all-out suppression may result in a pattern of extremes -- many small (most started by man) and few very large fires (Fahnstock, 1974). An indication of this pattern can be found in fire records for the chaparral of southern California (see table 3-4).

Table 3-3
Relationship Between Fire Size and Total
Acreage Burned for the Chaparral, 1910 to 1959

Year	Relationship Between Fire Size and Total Acreage Burned
1910	39% of fires burned 98% of 4,134,000 acreas
1920	20% of fires burned 94% of 342,000 acreas
1930	17% of fires burned 89% of 138,000 acreas
1940	13% of fires burned 95% of 228,000 acreas
1950	11% of fires burned 92% of 169,000 acreas
1959	8% of fires burned 92% of 217,000 acreas

Fortunately, the findings of recent research has forced a change of emphasis in the policy from fire control to fire management in land mangement agencies (Kilgore, 1976; DeBruin, 1976). The use of fire as a tool in land management has become accepted practice. Although it is almost impossible for man to avoid affecting fire-environment relationships, given a more accurate view of fire's role in nature, he can mitigate them wherever possible.

The impact of fire on man in terms of money and lives is well known (Davis, 1959). Since larger fires usually occur away from populated areas, economic losses are usually related to timber and lives to fire fighters. A major exception to this occurs in the chaparral covered hills of southern California. Brushfires are an inevitable part of the ecosystem and extensive suburban development in fire hazard areas has resulted in periodic large scale destruction and damage of homes and some loss of life (Biswell, 1974). Consequently, brushfires have become a factor in land use planning in Los Angeles county (Safety Element, Los Angeles County General Plan, 1973). Additional problems of this nature are possible in other areas given the rapid increase of second home development in forested areas.

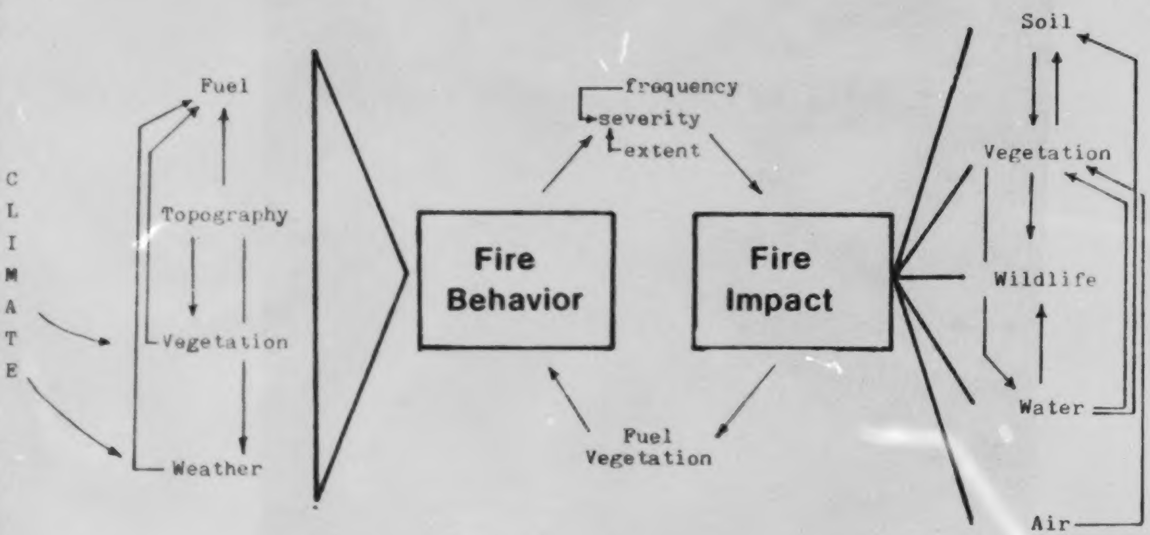
One fire-generated impact that has received increased attention recently has been smoke. Vogel (1974) points out that smoke has been equated with smog. He has added that, if this were the case, the indians never would have made it to North America -- "They had a choice, breath smoky air or freeze." (Vogel, personal communication). Beaufait (1972) notes that recent studies of smoke column contents reveal only carbon dioxide, water, and particulates present above background amounts. Such studies may have led Hall (1972) to conclude "....enough is known about smoke from woody fuels to indicate that its importance is limited almost entirely to visibility obstruction, an effect that can be minimized by proper timing and preparation for burning." However, Beaufait acknowledges possible air quality problems due to the generation of particulates. Sandberg and Pickford (1976) add that the generation of such pollutants as hydrocarbons, particulates, carbon monoxide, and oxides of nitrogen can vary with amount of fuel consumed, type of fuel, and the way a fire burns. Finally, Wake (1976), in a panel discussion of prescribed burning, took a position in diametric opposition to that of Hall (see above) describing smoke from slash burnings as a serious problem, not only because of particulates produced and decreased visibility, but possible synergistic reactions with other pollutants, and carbon monoxide production. He even predicts a demand for a complete ban of prescribed burning in the not too distant future (in Montanta) due to increasing air pollution regardless of the loss of certain types of trees in the process.

Obviously the problem is a complex one. The impact of smoke from prescribed or wildfires will vary with the fire and the environmental conditions under which it occurs. Undoubtedly, more research is needed to determine the scope of impacts and possible mitigating measures. It seems unlikely, though, that smoke can be equated with smog in terms of effects. Furthermore, to advocate restricting the use of fire to those instances where it is necessary for the protection of life and property, as advocated by Wake, above, is to ignore the ecological realities of the situation. Regardless of whether man burns slash or not, fires will occur and there is nothing, short of complete vegetation removal, that man can do about it.

3.5 Summary

Although the foregoing has been a limited exploration of fire-environment relationships, a number of conclusions can be drawn:

1. Fire-Environment interactions are complex and systematic. A simplified version is illustrated in figure 3-4.
2. Where conditions favor periodic occurrence of fire, it is an integral part of the ecosystem, not an outside disturbance, and is inevitable.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Vegetation
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severity
extent
Fire Behavior
Fire Impact
Fuel
Vegetation
Soil
Vegetation
Wildlife
Water
Air

Figure 3-4
The Fire-Environment System

3. Lightning is the primary natural ignition source.
4. A diversity of fuel-, weather-, or topographic-related environmental factors result in a broad range of ignition potentials and fire behaviors.
5. Variation of environmental factors over time and/or space means possible variation of behavior with a fire as well as between different fires. Consequently fire behavior is situation specific.
6. The impact of fire on the ecosystem depends on fire behavior.
7. Fire affects a variety of soil-, vegetative-, wildlife-, water-, and air-related environmental factors. Impacts are greatest on the soil, vegetative, and wildlife factors and a majority of impacts flow into or out of the vegetative component of the ecosystem.
8. Impacts occur both as a direct result of the fire and indirectly, generated by other direct or indirect impacts.
9. Possible impacts on soil include: changes in nutrient levels, erosion, removal of surface litter and duff layers, changes in surface texture, changes in soil moisture (both surface and subsurface), soil temperature changes (usually increases), and alteration of pH (increases).
10. Possible impacts on plant communities include: selective/non-selective kill and injury, changes in composition (changes can range from selective, resulting in maintenance, or whole-

sale, resulting in replacement), improvement in environmental conditions needed for reproduction (some species), stimulation of growth, temporary control of pathogens, long term influence on evolution through selection, mutation, and genetic drift.

11. Possible impacts on wildlife communities include: kill or injury, changes in food, water, and cover availability, increased competition, increase in food quality, increased exposure to elements and predators due to changes in cover, changes in diversity.
12. Possible impacts on water bodies include: changes in water chemistry, sediment load, temperature (primarily streams), increase in runoff, increase in stream flow (both annual and peak flows), changes in stream channel development.
13. Possible impacts on air include: generation of smoke and, in severe cases, high speed winds.
14. Due to the variability of fire behavior, a wide range of impacts are possible, and are therefore situation specific.
15. Man's historical influence on fire-environmental relationships has been to serve as an additional ignition source.
16. Man has effectively altered the natural fire-environment system through effective fire suppression.
17. Fire can be an important consideration in land management and land use planning.

In closing, the author would like to again point out that, although the specifics of the relationships discussed are unique to fire, their generalized nature is not. In any given ecosystem (natural or man-dominated), there are a great number of environmental forces at work, both living and non-living (including one of the more recent and powerful -- man). Like fire, each is affected by, and in turn affects other components of the ecosystem, generating impacts both directly and indirectly as they do so. A greater awareness and understanding of this dynamic aspect of the environment can help man obtain a greater insight to the world around him and his relationship to it.

Chapter 4

Development and Evaluation

4.1 Development

4.1.1 Introduction and Rationale

Why use fire[27] as a subject for environmental investigations? Fire is an extremely powerful environmental force but, unlike more common topics of investigation (trees, forests, water, soil, etc.), is transitory. Furthermore, the key to what it does in the environment lies in the changes it creates and those that follow. On the surface these may seem to be disadvantages. One cannot stand around waiting for a fire to occur and starting one's own is definitely frowned upon. In addition, the changes the fire sets in motion may take years -- a time frame unavailable for most environmental investigations. Yet these problems can be turned to advantages. The fire environment system is very dynamic. The inability to concentrate the investigation on the fire itself (i.e. the actual event) transfers the focus to things in the environment that affect or are affected by fire. Emphasis is placed on relationships, on the "connectedness" between things. Uncovering and exploring such relationships can help develop the concept of an interdependent, interrelated environment. Also, in thinking about the changes that occur after a fire, a learner is forced to extend his/her perspectives beyond the immediate consequences of the event -- something that, with respect to the environment, is relatively new even among planners and developers.

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[27] Fire as used here refers to forest, brush, or grassland fires.

Add man to the system and learning potential is expanded. Because of fires' destructive/beneficial nature, it presents a land management policy problem and is a factor to consider in land use. With respect to the latter, the land use decision-making process can be explored through investigating fires' influence on it. What are some alternative solutions to a fire problem? What tradeoffs are involved? What interest groups would be affected? How? Which alternatives would each interest group favor? Why? How do the interest groups relate to one another, to the decision-making process? These are a few of the questions that can be raised.

It should be noted here that this education potential is not unique to fire. Other environmental forces (some anthropocentrically labeled "natural disasters") such as floods, windstorms, insect outbreaks, etc., have similar characteristics (i.e. transitory, setting changes in motion) and so may be similar resources for learning experiences. Even man, through some of his actions, could be put in that category. Clearcut logging, farming, even mowing grass are, in some ways, ecological similar to fire. Fire, however, was chosen for three reasons: (1) the subject is of interest to the author, (2) fire is a very dynamic and misunderstood force, and (3) the topic was identified in the terms of the grant under which the author worked.

In addition to being a vehicle to get at larger environmental understandings, environmental investigations involving fire can help lay the groundwork for greater public acceptance of land management agency policies concerning fire. The shift in philosophy from fire control (fires will be suppressed at all times) to fire management (options range from full to no suppression and includes the use of fire as a management tool) by agencies such as the U.S. Park and Forest Services carries with it potential public relations problems -- problems that education can help solve. Stankey (1976), in studying wilderness user attitudes toward fire suppression, found a strong relationship between high test scores on a fire knowledge test and the acceptance of statements favoring modified suppression policies. Based on his study, Stankey recommended educating and involving the public and, given the diverse nature of the "general public," the use of a diverse package of communication programs. These programs would provide a more accurate basis with which people could evaluate management decisions regarding fire and increase (hopefully!) chances of public acceptance of natural fire zone[28] and controlled burning management policies.[29]

4.1.2 Previous Fire Related Educational Material

The educational material available regarding fire is mixed. Most of it concerns fire behavior and is used to prepare land management personnel for fire-fighting duties. There is a small but increasing amount of interpretive material concerning fires' role in the environment as land management agencies seek to correct misconceptions of the past. An example of these is a booklet, "The Natural Role of Fire," published jointly by the U.S. Park and Forest Services which explains how fire fits into the ecology of the Rocky Mountain forests and some of the problems involved in fire management. More often talks and/or audio-visual presentations are integrated into the overall interpretive program in areas where fire effects are actually or potentially visible.

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[28] A natural fire zone is a designated area of land where, for management purposes, natural fires are allowed to burn themselves out (except when endangering lives or property). They are primarily used in National Parks and Wilderness areas.

[29] Controlled or prescribed burning is the use of fire as a tool to accomplish a specific purpose in a specific area. In contrast to fires of natural origin, controlled burns are set by man.

There is very little in these approaches, though, that actively involves the learner in investigating fire-environment-man relationships. Pager and Heilman (undated) developed a lesson plan using the process approach for investigating the effects of fire on the forest environment. Two of the six tasks (activities) however, concern the use of fire suppression tools, while one other involves fighting a simulated fire. Only two of the six tasks actually explore the effects of fire on the forest. In addition, the lesson plan requires the availability of a recently-burned-over area -- something the author feels severely limits its applicability.[30] These and other problems have led to the conclusion that it would not provide participants with the potential learning experience the author considers possible. Sellers (1975)

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30 It should be noted that the lesson plan was designed for use with UCC and teacher/leader workshops. Burned over areas may be more readily available under those conditions.

developed a program in which high school biology students undertook a scientific study to determine if fire was the main influence on black oak reproduction and survival in Kings Canyon National Park, California. The students followed the usual research approach -- literature review experimental design, collecting data, interpreting it, and summarizing results and conclusion, which are then discussed by the class. Sellers reported success in meeting objectives relating to data analysis and interpretation, and the communication of that through discussion and written reports. He also reports student satisfaction in gathering useful data for the Park Service and student development of "spin-off" independent projects. While the project provided an effective learning experience (based on Sellers results), several conditions under which it occurred limit applicability: (1) Proximity of a land management agency that has land suitable for fire research and the willingness to allow high school students to use it, (2) Presence of an instructor knowledgeable in both fire ecology and research methods, and (3) The availability of suitable plant sampling equipment. Also although a literature review was accomplished by the students, Sellers does not elaborate as to whether the discussion involved in the study went beyond fires' effect on vegetation. Therefore just how much of the fire -- environment relationships were explored is unclear. Finally, the U.S. Fish and Wildlife Service (1975) has sponsored the production of a series of environmental education activities under the title "We Can Help!". One of these activities is an investigation into fire ecology.

Basically it is a discussion of fire behavior (through a discussion of controlled burning), followed by a comparison of vegetative diversity and patterns on burned and unburned plots using a vegetative mapping technique described in the activity. Differences in wildlife use are considered in the follow-up discussion. This approach has some of the same limitations as that of Sellers. The discussion of controlled burning requires a discussion leader versed in that aspect of fire management (the activity suggests the staff of a wildlife refuge as a source). A burned-over area is also required as well as a roughly equivalent (in terms of vegetation) unburned area for comparison. In addition the activity appears to be written for use at a U.S. Fish and Wildlife refuge (e.g. in the directions for planning the activity the instructor is directed to contact the refuge manager for information and assistance). However, there is nothing in the lesson plan itself that limits use to a wildlife refuge.

Educational efforts using fire, then, have been primarily confined to preparing resource agency people to fight fires and, to a lesser extent, public information/relations material used by land management agencies. Those attempts that have been made at active, learner-involving investigations have been localized and/or limited by setting or material requirements.

As mentioned earlier, one of the reasons for the selection of the process approach as the instructional strategy used was a request for its use by the sponsors of this project. More importantly though it fits the author's concept of an EE process. The use of a questioning/task card strategy allows the learner to take an active role in the learning experience. This, combined with the managerial role taken by the instructor, makes the experience learner-centered rather than teacher-centered. Because the process approach is a way of getting people involved in investigating their environment, it is not oriented to a particular discipline and so can easily assume an interdisciplinary nature. Finally, as pointed out by Carroll (1975), learners are involved in problem-solving situations. By utilizing interpretation-of-data/application processes in problem-solving situations, the learning potential of the experience can be raised to higher cognitive levels.

If the only goal the author had was to "get across" information about fire-environment-man relationships, a book, pamphlet or lecture might suffice. The use of an instructional methodology -- like the process approach -- which asks the learner to collect and process data rather than having the data collected and digested for them by someone else (e.g. the instructor) lifts the potential learning experience beyond the facts and figures level. The learner has the opportunity to engage in and develop cognitive skills necessary for problem-solving ability -- itself a skill that is invaluable in enabling individuals to function more effectively in society. The author is aware that by itself, one set of process-oriented materials, whether investigating fire or anything else, is not likely to result in the acquisition of generalized problem-solving ability by learners. Such acquisition is a gradual process and many more experiences are needed (e.g. Taba, 1966 ran her study over an entire school year to provide students with plenty of opportunity to use such skills). Several individual experiences can provide building blocks for a series of experiences from which these skills eventually emerge.

Fire is not often thought of as an educational resource. Yet the way fire influences and is influenced by the environment can provide fertile ground for exploring environmental relationships and insights into the "interconnectedness" among elements of the environment. Include man, and the learning experience can extend into land use/management planning and decision making. The use of the process approach allows active learner participation creates the potential for extending the learning experience beyond the acquisition of knowledge level into cognitive thinking processes and awareness.

4.1.3 Development Method

Although one of the major goals of the process approach workshop program is the development of process approach skills in participants so they can apply the skills to learning situations (Reider, unpublished data), no overall systematized method is offered within the workshop to create such learning experience.[31] The reason for this lack is not clear. Perhaps it is a reflection of the perception of teachers as the primary target group for workshops by those in charge of the regional workshop programs (Reider, unpublished data). Presumably teachers would already possess their own methods. However, other target groups exist besides teachers (Forest Service and other Federal Agency personnel, state and local resource people, others involved in EE, etc.) that cannot be expected to enter the workshop with such knowledge. In order to apply the process approach to creating a learning experience, these participants will have to develop their own method which, in this case is exactly what was done.

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[31] There is a "Lesson Plan for Developing Environmental Investigations." However, it is primarily concerned with use of the open, focus, interpretive/application, summary task card sequence, construction of task cards, use of discussion skills, and the overall format of the

The framework for the development method used was taken from the basic graphical definition of a systematic approach by Twelker, Urbach, and Buck (1972) -- figure 4-1 -- and work by Gerlach and Ely (1971). The latter identified ten areas in their model of an instructional system:

1. specification of objectives
2. selection of content

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lesson plan. There are also activities on writing objectives, but they are not included in the lesson plan nor are they directly related to the development process. The closest thing to a systemized method in the workshop materials the author has seen are the following two questions under the heading "Some ideas to explore before planning a learning experience:"

(a) What is the purpose of the investigation or activity I'm planning?

(b) How can I structure the learning experience to insure participation and the development of thinking processes along with the use of factual data, etc.?

3. assessment of entering behaviors
4. strategy employed
5. organizing the students into groups
6. allocation of time
7. allocation of learning spaces (physical space)
8. selection of appropriate learning resources
9. evaluation
10. analysis of feedback

Elements of these were adapted, others added, and fit into the overall define-develop-evaluate-revise framework resulting in the approach depicted graphically in figure 4-2. Gerlach and Ely note that any graphic model such as theirs (not shown) is a static representation of a dynamic process. Although there is a sequence defined, the elements within the model used here are interrelated so one step is never done in total isolation from previous decisions in earlier steps and/or anticipated factors in later steps. Furthermore, tradeoffs may have to be made between factors. This interplay, feedback, and occasional "balancing act" gives the process its dynamic character.

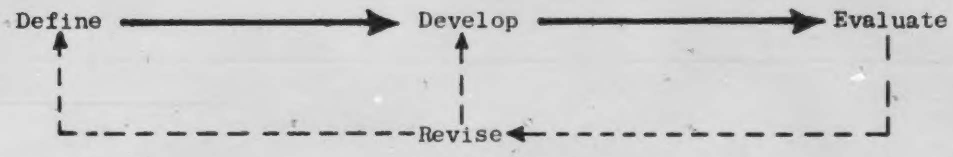

Figure 4-1
Generalized Systematic Approach

(After Twelker, Urbach, and Buch, 1972)

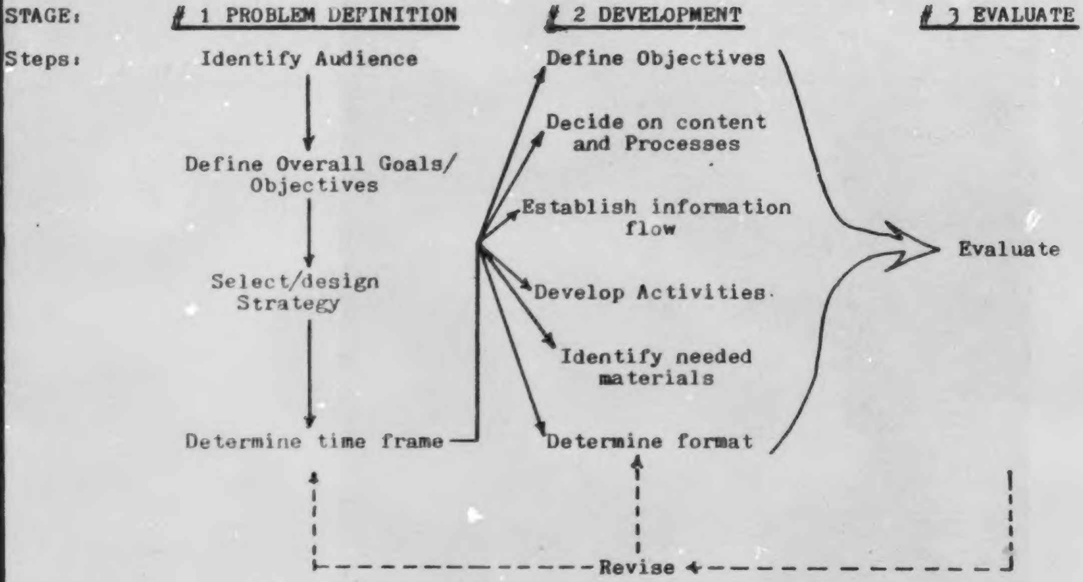
STAGE:
# 1 PROBLEM DEFINITION
# 2 DEVELOPMENT
# 3 EVALUATE
Steps:
Identify Audience
Define Overall Goals/ Objectives
Select/design Strategy
Determine time frame
Define Objectives
Decide on content and Processes
Establish information flow
Develop Activities
Identify needed materials
Determine format
Evaluate
Revise

Figure 4-2
Instructional Design Method for Development of Lesson Plans

4.1.4 Problem Definition

In a very broad sense, the problem has been identified earlier -- the development of learning experiences investigating the role of fire in the environment, using the process approach as the instructional method. Before actual design of the learning experience was begun, however, the problem was further refined in order to build a better framework in which to work. This was done by (1) identifying the audience, (2) defining overall goals/objectives, (3) selecting/designing a strategy, and (4) determining a time frame.

The audience identified for the investigations were adults, primarily workshop participants and, to a lesser extent, in-service technicians. A secondary target of High School students was also identified. Their knowledge concerning fire-environment relationships was assumed to be low and their attitude toward fire negative (at best neutral). There is little hard data to support either assumption, although slightly more for the latter. Concerning the former, Stankey (1976) found that fire-ecology knowledge of Selway-Bitterroot Wilderness users was generally poor regardless of age, sex, or general education level. With regard to attitudes, Stankey cites a study by Hendee and others (1968) and unpublished data by Lucas. The former found that a vast majority of respondents felt that man-caused wilderness fires should be put out (98%), that lightning fires should not be allowed to run their course (95%), and that wilderness burns should be restored as soon as possible (90%). Lucas's data (from wilderness and dispersed recreation area users) show 50% opposing natural fires in wilderness, 16% seeing them as desirable, and 23% neutral (10% not sure enough to answer). Stankey himself found that while a majority of wilderness users still favored suppression (62%), a sizable minority did favor letting what was characterized as small, safe fires burn (30%), while some favored even more modified suppression (8%). While these studies are helpful in getting an idea of attitudes toward fire, it should be kept in mind that the respondents were all (with the partial expection of Luca's study) wilderness users -- not the general public. Yet they do indicate a continuing "total suppression" attitude in at least one segment of the general public.

The basis for assuming a neutral or negative attitude among the general public also rests on the "bad press" that fire receives. Exposure through the media has been virtually limited to very large and destructive fires, particularly if they have burned or are threatening to burn residential areas as in southern California. Given this, and the "fire-is-bad-because-it-kills-animals-and-trees" message in the Smokey the Bear program, one could reasonably expect attitudes toward fire to be negative.

Finally, the audience knowledge of ecological relationships in general was assumed to be low. Although this may not hold true for all workshop situations, all participants (the workshop audience is usually fairly mixed), or all in-service technicians, to assume otherwise raises the possibility of losing, frustrating, or boring those unfamiliar with the terms and concepts.

Goals and objectives identify end points -- where the learner is supposed to end up. Analysis of goals and objectives was done using a "pyramiding objectives" method devised by Pipe (1966) for developing programmed learning material. Pyramiding objectives involves defining an overall generalized goal(s), translating that goal(s) into a behavioral objective(s), then successively breaking down that objectives(S) into smaller and smaller components until a point is reached at which the designer feels the learning experience can begin (Pipe defines this as the point at which one is dealing with skills/knowledge the learner can be expected to bring into the learning experience). At this stage in the development process though, only overall goals[32] were identified. These were:

(1) To develop in the learner an understanding and awareness of environment-fire-man relationships which can be used as a basis for evaluating land management decisions in which fire is a factor.

(2) Increase learner awareness of the "interconnectedness" of environmental factors.

(3) Provide the learner the opportunity to use and develop cognitive process skills.

Since the first goal serves as the vehicle to carry out the latter two, all objectives were defined in the context of the former. The overall objectives were defined as follows:

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[32] These goals/objectives reflect the desire expressed by people in the Forest Service to go beyond the usual fire prevention orientation.

Given participation in the learning experience and completion of the tasks, an environment in which fire plays a role, and the relevant characteristics of that environment, the learner will be able to:

(a) Generally predict the likelihood (high-medium-low) and kind of fire that might occur, based on the natural environmental conditions.

(b) Infer the effects of such a fire on the living and non-living parts of the environment.

(c) Describe what effects periodic fires could have on land use/management.

The instructional strategy to be used has already been outlined in chapter two and the rationale behind its use discussed earlier.

The use of the learning experiences in a workshop situation defined a time frame of 3-1/2 to 4 hours. Lesson plans with such a time frame are also usable in Youth Conservation Camp (YCC) programs. However, a time frame of that length does present a problem in a high school situation (unless used on a field trip or some other longer term activity). To help mitigate this problem, activities, where possible, were restricted to under 40 minutes. Hopefully the instructor could: (1) stretch the investigation over a series of separate time periods, (2) use an individual or a series of tasks separately as desired, (3) modify the tasks to meet his needs (time and otherwise), and (4) failing the above, use the material as an idea source to produce a learning experience better suited to the instructor's needs.

4.1.5 Development

By using an adaptation of Pipe's (1966) "pyramiding objectives" methods[33] three development operations were combined into one. By defining objectives, both content and processes were at least partially determined. Putting them in sequence established the flow of information.[34] The analysis was conducted by beginning at the overall objective and working backwards by asking a series of "if/then" questions. For example: "If the learner is to generally predict fire behavior, then he or she must know how the basic environmental factors affect fire." In this way successively narrower components of the learning experience were identified. Figure 4-3 illustrates this process. Specific objectives[35] were then written based on the components defined during the analysis.

Of course, as mentioned before, this procedure resulted in a winnowing of subject content. Blow-up behavior of fires was not explored due to its complexity. Topographical influences other than

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[33] Pipe began with a major overall behavioral objective and, through a branching process, broke it down into groups of successively narrower ones. The author found it easier to break down the overall objective into narrower components and then write objectives, rather than work with objectives directly.

[34] The flow of information within a learning experience (as in any communication) refers to the relationship between activities/ideas and the transitions between them. Does one idea lead smoothly to another or is the learner jerked out of one and thrown into another?

[35] See the back of the lesson plan concerned or tables 4-1, -2, -3.

Overall Objective

Given participation in the learning experience and completion of the tasks, an environment in which fire plays a role, and the relevant characteristics of that environment, the learner will be able to:

(a) Generally predict and describe the likelihood of a fire (high-medium-low) and the kind that might occur based on the natural environmental conditions.

(b) Infer the effects of such a fire on the living and non-living parts of the environment.

(c) Describe what effects periodic fires could have on land use/management.

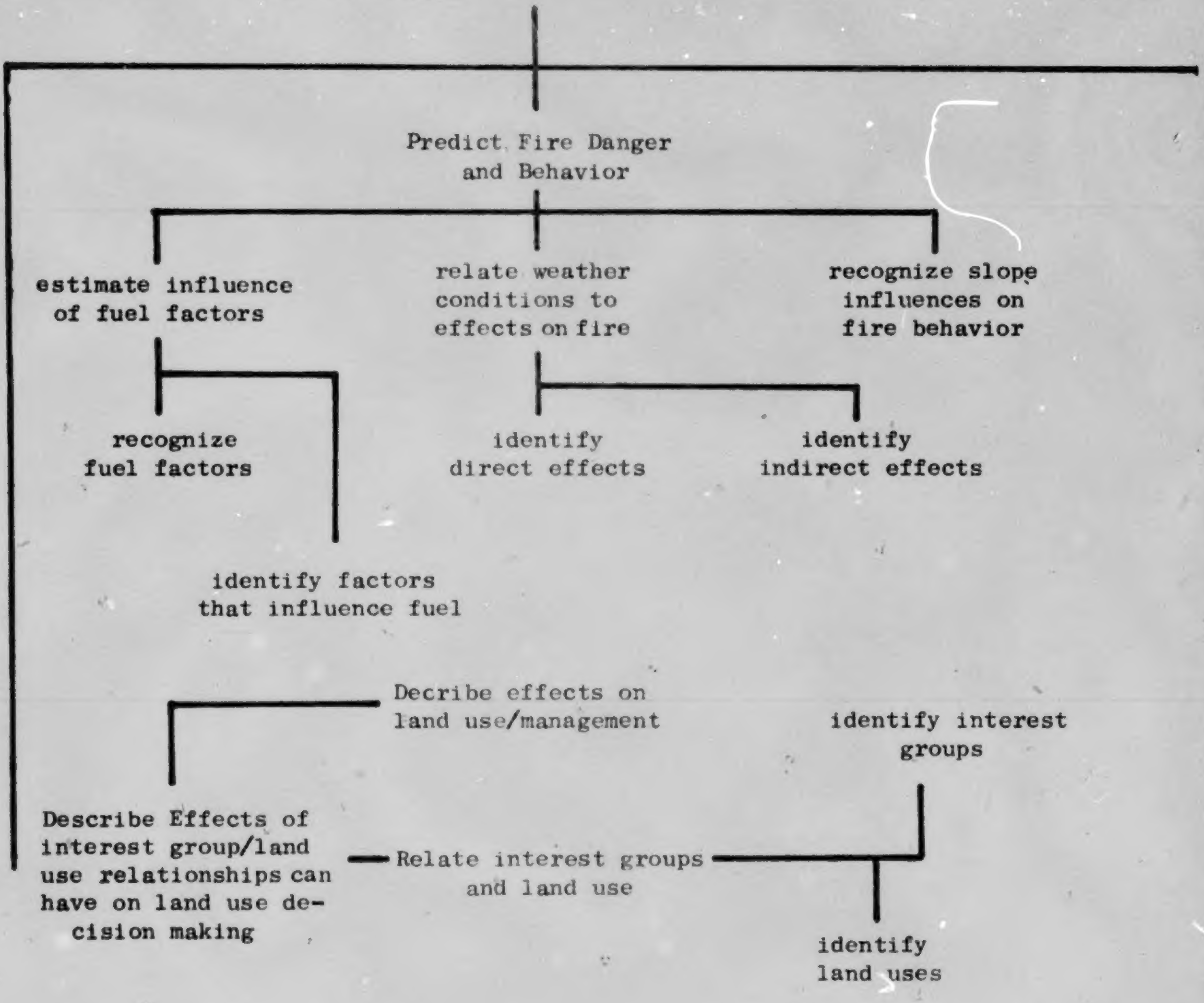
Predict Fire Danger and Behavior
estimate influence of fuel factors
relate weather conditions to effects on fire
recognize slope influences on fire behavior
recognize fuel factors
identify direct effects
identify indirect effects
identify factors that influence fuel
Decribe effects on land use/management
identify interest groups
Describe Effects of interest group/land use relationships can have on land use decision making
Relate interest groups and land use
identify land uses

Figure 4-3.
Lesson Plan Component Breakdown

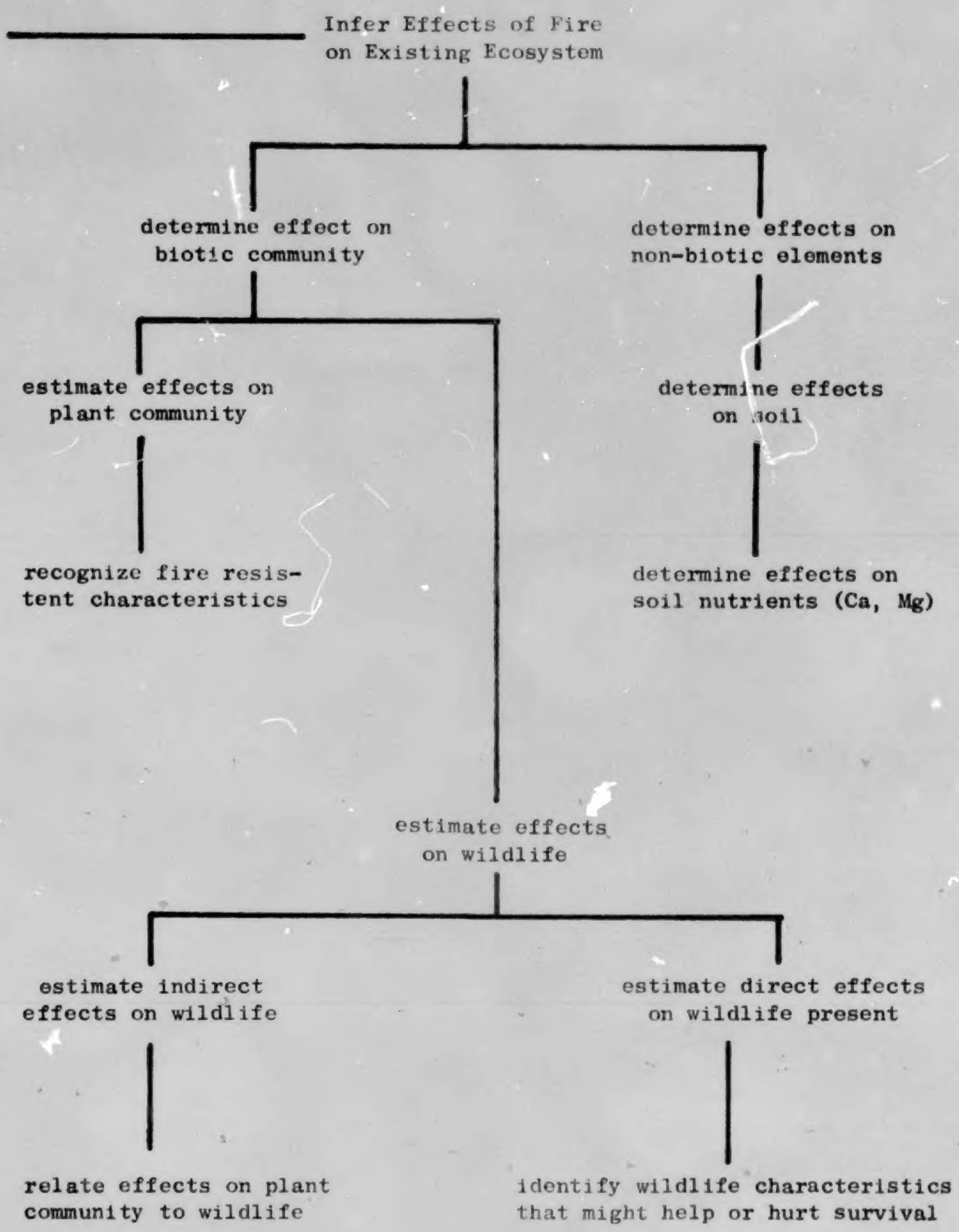
Infer Effects of Fire on Existing Ecosystem
determine effect on biotic community
determine effects on non-biotic elements
estimate effects on plant community
determine effects on soil
recognize fire resistent characteristics
determine effects on soil nutrients (Ca, Mg)
estimate effects on wildlife
estimate indirect effects on wildlife
estimate direct effects on wildlife present
relate effects on plant community to wildlife
identify wildlife characteristics that might help or hurt survival

Figure 4-3 Continued.

slope (elevation, aspect, relief) were also dropped. Limitations in time, materials, and difficulty in investigation precluded their use. The investigation of fire's effects on soil was limited to nutrients (calcium, magnesium) for similar reasons. Undoubtedly such restrictions reflect on the completeness of the learning experience with regard to content (i.e. factual information. Content can also refer to everything within a learning experience -- process, awareness as well as facts.). However, acquiring content is not the only goal addressed. Awareness and use of thinking processes are also concerns. Furthermore, a complete grasp of fire ecology is not necessary to explore the relationships between fire and the environment. For these reasons the author feels the content limitations are not serious drawbacks.

A slightly different approach was taken in the analysis of the fire -- land use/management related objectives. The brushfire problem in the residentially developed Hills in Los Angeles county provided an excellent example of the way fire can affect people and land use. A review of simulation gaming literature (see appendix four) indicated that this particular instructional strategy was ideally suited for exploring such dynamic situations. Rather than looking at it from the outside, the learner becomes part of it (albeit in a simplified version) by playing some sort of role. Involvement can give the learner a "feel" for the situation -- an understanding that extends beyond the cognitive into the motivation and attitudes of people in the real-life situation being simulated. This kind of empathetic understanding may account for the ability of simulation games to develop or change attitudes (Boocock, 1968; Baker, 1968; Livingston and Kidder, 1973). Given the above, the decision was made to use a specific activity before all objectives for the lesson plan had been defined. Following the development of the major activity introductory and follow-up objectives and tasks were developed.

Once objectives had been specified, a sequence of tasks and discussion questions were developed to accomplish them. In the process of doing this, it became apparent that a single lesson plan 3-1/2 to 4 hours long was not going to be sufficient. Since the overall topic broke down naturally into three areas: (A) environmental influences on fire, (B) fire's influence on the environment, and (C) fire's influence on man,[36] the decision was made to generate a 3-1/2 to 4 hour lesson plan for each subtopic. In the case of (A) and (B), development of tasks/discussion questions began at the narrowest components and worked toward the larger ones. For example, in (A) tasks/discussion questions exploring weather, fuel, and slope influences on fire were developed first, then tasks applying that information to predict fire behavior and likelihood. Part (C) was an exception to this procedure the simulation game was developed first, after which tasks/discussion questions preceding and following it were generated. Tables 4-1, 4-2, and 4-3 indicate for each lesson plan the relationship between objectives and tasks/discussion questions, plus the flow of the

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[36] Man influences fire by affecting fire behavior and increasing the number of ignition sources. These can be considered under environmental influences on fire.

Table 4-1
Relationship Between Tasks/Discussion Questions and Objectives, Lesson Plan A

Lesson Plan A is an investigation of fire behavior. It begins with introductory tasks, moves to explorations of each of the basic environmental influences on fire, then asks the learner to apply the information uncovered and other background information provided; to make predictions of fire danger and behavior for a particular area.

Defined Objectives Key

1. Determine, through investigation of particular environment, if a fire has occurred there recently.

2. Identify at least three different kinds of fuels.

3. Evaluate the relatively burnability of an environmental fuel (high/low) based on observations of that fuel; and explain the rationale behind his evaluation in his own words.

4. Identify three things in the environment that can influence fire and describe in their own words, how each can affect it.

5. Construct a scale drawing after determining its size in relation to the original.

6. Calculate rate, given time and distance.

7. Generally predict the likelihood of fire in a given area.

8. Predict and describe, in his own words the kind of fire that might develop in a particular area.

Table 4-1 Continued.

Tasks/ Discussion	Purpose	Objectives	Processes	Open/Focus/ Interpretation-Application/ Summary Class
Task A	Introductory, give learners a chance to relate to where they are. Assumes they are not familiar with the area.	None	observing	open
Discussion between A and B	Focus investigation on fire.	1	observing	open/focus
Task B	Introduce learner to traces fire leaves in environment.	1	observing, translating	focus
Discussion between B and C	Interpret data collected in Task B. Transition between introductory tasks and fuel investigation.	1,2,3	relating, infering	open (1)* summary (2) open/focus (3-5)
Task C	Close observation of fuels. Gather data for Task D.	2	observing, translating	focus
Discussion between C and D	Share observations as group to increase group resources in preparation for Task D.	3	translating	open
Task D	Application of data to estimate burnability of fuel	3	relating, infering, predicting	interpretive-application
Discussion between D and E	Share observations as group to increase knowledge base (1,2). Transition to Task E (3,4).	3	relating, infering	interpretive-application

*Numbers in parenthesis are the numbers of the discussion questions concerned.

Table 4-1 Continued.

Tasks/ Discussion	Purpose	Objectives	Processes	Open/Focus/ Interpretation- Application/ Summary Class
Task E	Generate a list of weather factors.	4	observing, recalling	open
Discussion between E and F	Pool individual results of Task E and focus on 3-4 of them for Task F.	4	recalling	focus
Task F	Establish a relationship between weather and fire.	4	relating, infering, verifying	interpretation-application
Discussion between F and G	Summarize weather and fire relationship and transition to Task G.	4	relating, infering, generalizing	summary
Tasks G-J	Provide the learner with the opportunity to actually observe and investigate slope-fire relationships.	4,5,6	observing, infering, predicting	focus interpretation-application
Discussion between J and K	Share and compare group data to draw conclusions. Summarize slope-fire relationships. Introduce Task K.	4	observing, infering, recalling, generalizing	interpretation-application (2,3), summary (4), focus (1, 2 - intro. to task K)
Task K	Gather data for use in Task L.	4,7,8	observing translating	focus
Task L	Interpret data and make predictions.	4,7,8	relating, infering, predicting	interpretation-application
End Discussion	Share predictions. Summarize what was found out during the investigation and explore applications of it in other circumstances.	4,7,8	relating, infering, generalizing	interpretation-application (2,3), summary (4).

Table 4-2
Relationship between Tasks/Discussion Questions and Objectives,
Lesson Plan B

Lesson Plan B, Fire and the Natural Environment, is an investigation of the effects fire has on the natural environment. It begins with introductory tasks, that, if the lesson plan is done after lesson plan A, can be eliminated. From these it moves to an investigation of plant adaptations that can make a plant species resistant to fire; how fire can mold the development of a plant community through these adaptations; explores fires effect on animals, both directly and indirectly; and closes with tasks examining fire-soil relationships, with emphasis on soil fertility.

Defined Objectives Key

1. Determine, for a given area, if a fire has occurred recently.
2. Identify at least two plant adaptations to fire and determine whether they would help the plant itself to survive or insure the next generation.
3. Infer the presence or absence of fire as an environmental influence from the characteristics of the common plants of a particular environment.
4. Identify at least three ways fire can affect wildlife.
5. Predict the susceptability of an animal to fire, given its characteristics.
6. Identify at least two non-living parts of the environment and describe in his/her own words how fire could affect it.
7. Use the water test kit to determine the calcium and magnesium content of litter and ashes.

Table 4-2. Continued.

Tasks/ Discussion Questions	Purpose	Related Objectives	Processes	Open/Focus/ Interpretation-Application/ Summary Structure
Task A	Introductory. Give learners a change to relate to where they are. Assumes they are not familiar with area.	none	observing translating	open
Discussion A-B	Focus investigation on fire.	1	observing	open-focus
Task B	Introduce learners to possible traces fire leaves in environment.	1	observing	focus
Discussion B-C	Summarize findings. Transition to task C.	2	relating	open (1)* summary (2), focus (4) interpretation-application (5)
Task C	Introduce learner to adaptation and relating it to fire.	2	translating, relating, infering	focus/ interpretation-application
Discussion C-D	Transition to Task D.	N/A	N/A	N/A
Task D	Apply ideas to Task C to actual plant species. Relate plant species characteristics to fire survival ability.	2,3	observing, relating, infering	interpretation-application
Discussion D-E	Share information. Categorize adaptations as contributing toward maintenance (individual survival) or replacement (insuring a new generation)	2,3	relating, infering, generalizing	open (1), focus/ interpretation-application (2,3), summary (4).

*Numbers in parentheses correspond to the number of the discussion question concerned.

Table 4-2. Continued.

Tasks/ Discussion Questions	Purpose	Related Objectives	Processes	Open/Focus/ Interpretation-Application/ Summary Structure
Task E	Apply knowledge from task C and D to predict effect of periodic fire on a plant community.	2,3	observing, relating, infering, predicting	interpretation-application
Discussion E-F	Share predictions. Summarize plant-fire relationships, and transition to animal-fire relationships.	2,3,4	relating, generalizing, predicting	open (2) focus/interpretation-application (3)
Task F	Have learner relate animal characteristics to ability to survive fire.	4	observing, relating	summary (4) focus/interpretation-application
Discussion F-G	Pool results within group. Transition to task G	4	relating	open (1)
Task G	Relate changes produced by fire to needs of animals.	4	relating, infering, predicting	interpretation-application
Discussion G-H	Share changes and relate them to animals.	4	relating	open (1) interpretation-application (3,4)
Task H	Add time perspective to changes brought about by fire and relate animal needs to continued changes.	4	relating, infering, predicting	interpretation-application
Discussion H-I	Share predictions. Explore possible uses of fire as a management tool. Summarize fire-animal relationships. Transition to Task I.	4	relating, infering, generalizing	open (1) focus/interpretation-(2,3) summary (4)

Table 4-2. Continued.

Tasks/ Discussion Questions	Purpose	Related Objectives	Processes	Open/Focus/ Interpretation-Application/ Summary Structure
Task I	Introduce learner to observable soil characteristics.	6	observing, translating	open
Discussion I-J	Relate fire to soil characteristics. Introduce other less easily observable soil characteristics.	6	relating, infering	open (1) focus (2) interpretation-application (3) open (4)
Task J	Provide data on soil fertility (Ca and Mg) for later comparison.	6,7	observing	focus
Discussion J-K	Transition to task K.	6	infering	focus
Task K	Provide data for comparison and discussion.	6	observing	focus
Discussion K-end	Interpret data collected	all	observing, relating, infering, generalizing	focus (1) interpretation-application (2,3) summary (4,6) open (5)

Table 4-3
Relationship Between Tasks/Discussion Questions and Objectives, Lesson Plan C

Lesson plan C, Land Use, Interest Groups, and Fire, is an investigation exploring interest group relationships, both among interest groups and with land use, using a situation where fire influences land use. It begins with tasks relating land use and interest groups, moves to a simulation/game that puts the participant in the role of an interest group involved in a situation resulting from the effects of fire on land use, and closes after considering what makes community interest groups powerful and summarizing the participants findings.

Defined Objectives Key

1. Given an aerial photograph (roughly 1:24,000 scale), identify at least three types of land use.
2. Define, in their own words, the term interest group.
3. Given a situation where an actual or potential change in land use exists: (a) identify at least three interest groups that would be affected by the change; (b) analyze the relationships between the interest groups and the land use in terms of advantages and disadvantages the land use change offers the interest groups; and (c) describe in their own words the impact interest groups as a whole have on land use decision-making.
4. Identify three interest groups in their own community.
5. Describe two or more factors that make one interest group more influential than another.
6. Describe the affect periodic natural fires can have on land use in an urban or suburban situation.

Table 4-3. Continued.

Tasks/ Discussion Questions	Purpose	Related Objectives	Processes	Open/Focus/ Interpretation-Application/ Summary Structure
Task A	Generate a list of land uses.	1	observing	open
Dicussion A-B	Introduce idea and generate a list of interest groups.	2,3,4	relating	focus
Task B	Explore relationship between land use and interest groups.	3,4	relating infering	interpretation-application
Dicussion B-C	Share relationship with whole group, relate relationships to land use decision-making and introduce simulation/game.	2,3,4	observing, relating, infering	interpretation-application, (3,4) open-focus (1)
Task C and Sim/game	Involve participant in interest group interactions, explore effects of fire on land use.	2,3,6	all	interpretation-application
Discussion C-D	Explore what happened in simulation/game and relate to real life.	2,3,5,6	all	all
Task D	Relate to participant's community, investigate interest group power, provide data for discussion.	4,5	recalling relating	focus-interpretation
Discussion to end	Share results of Task D, consider what makes interest groups powerful, summarize investigation.	2,6	recalling, infering, generalizing	open (1), focus (2), interpretation-application (3,4) summary (5)

open-focus-interpretive/application-summary structure.

Two overall guidelines were followed in determining the type and amount of materials to be used:

(1) A burned-over area should not be a requirement; this presents a severe restriction in previous material.

(2) No special equipment should be needed that cannot be constructed from easily obtainable, inexpensive materials or is readily available through other sources. This, for example, ruled out the use of fuel moisture sticks in the tasks for predicting fire danger and behavior.

Finally, a slide/tape program on fire was produced as a parallel project. Although independent of the lesson plans, one of the goals in the development of "The Other Side of The Flame" was to provide background information for instructors who might want to use the lesson plans. The slide/tape program will be available through both the Forest Service and the SUNY College of Environmental Science and Forestry. A copy of the script is in appendix three.

4.2 Evaluation

4.2.1 Introduction

While full scale evaluation involving pre- and post-testing for cognitive and affective changes was beyond the scope of the study as defined, a preliminary evaluation of some kind was considered to be useful in identifying problem areas and suggesting improvements, However, limited opportunities for field testing led to the selection of an alternate method of evaluation.

4.2.2 Method

4.2.2.1 Evaluation Methods Chosen

The method selected was an evaluation of the lesson plans by facilitators[37] experienced in using the process approach. A mail questionnaire was used because it offered an inexpensive way to reach the target audience (Berdie and Anderson, 1974) and allowed the respondent to work on the questionnaire intermittently. Of course, the use of a questionnaire involves the assumption that respondents will give truthful answers (Berdie and Anderson, 1974) -- in this case an accurate reflection of their opinions.

In addition, the simulation game in lesson plan C (LP C) was run in an advanced ninth grade biology class at Baldwinsville High School, Baldwinsville, N.Y. Also, parts of LP A, B, and C were "quasi" field tested with two very small groups of volunteer students from the same high school.

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[37] "Facilitator" is the term used to describe instructors in the process approach workshops.

4.2.2.2 Questionnaire Development

Evaluation focused on three areas: (1) Possible problem areas and use potential, (2) Adaptability for shortening of the lesson plan by deleting tasks and possible individual task use out of context, and (3) Suggestions for improvement. Each area was represented by a separate section on the questionnaire which in turn was developed using guidelines established by Berdie and Anderson (1974). After initial development, the draft version was "test used" by Mr. Jim Unterwegner, education specialist, U.S. Forest Service, and was reviewed by individuals experienced in questionnaire construction. The questionnaire was then revised, based on the suggestions of the reviewers and the responses and comments of Mr. Unterwegner. The final version was intended to be as concise and easy to complete as possible. Four types of questions were used: "yes or no," multiple choice items, ranking and open-ended questions.

Nine background questions were used to obtain information concerning facilitator and other educational experience, and gather data concerning respondent perceptions of fire.

In Part I of the evaluation questionnaire, questions 1 through 6 ask the respondent to rate the lesson plan on a scale from one to five with respect to potential problem areas defined by the author. These were clarity of directions, estimated time frame of tasks, objectives/lesson plan relationship, flow of information, ease of use, and materials.

Question 7 checks the use potential of the lesson plan to the respondent. Question 8 asks the respondent to compare the fire lesson plan with the established field investigations in use at process approach workshops which are supposed to be paradigms of the process approach. Teachers were asked to rate the lesson plans as educational experiences for their students.

Part II of the questionnaire explored respondent opinions concerning adaptability for both shortening and independent, individual use of the tasks. Respondents were asked to indicate (1) whether they thought the lesson plan could be shortened by deleting tasks, if so, (2) which tasks they would delete, and (3) rank those tasks as to which they would delete first, second, third, etc. Respondents were also asked to identify those tasks, if any, they felt could be used out of context as learning experiences. This was a check on the relative independence of the tasks.

Finally, Part III was primarily intended to solicit specific suggestions for improvement, preferably on the lesson plan itself. It also offered the respondent the opportunity to make any other comments he felt were relevant.

4.2.2.3 Survey Design and Implementation

The target audience for the survey, as mentioned before, was experienced facilitators. Mr. Jefferson Carroll, National Coordinator for the Forest Service EE programs, provided a list of 32 facilitators.

These people, along with a few others with which the author had previous contact (and later nine teachers) made up the sample population.

The questionnaire for lesson plans A, B, and C were identical in content with the exception of the number of tasks listed in Part II. Evaluation questionnaires and corresponding lesson plans were color coded to decrease the chances of questionnaire mix-up by respondents or author. The final survey package contained: (1) a cover letter briefly describing the project and requesting the respondent's cooperation, (2) directions for the evaluation survey, (3) a sheet for background questions with attached map of Forest Service regions, and (4) one copy each of lesson plans A, B, and C, with corresponding evaluation questionnaires attached. A copy of the survey package can be found in appendix one.

Initial contact was accomplished in two ways. Since the nine regional heads of Forest Service EE programs and two former heads were going to be personally contacted to obtain information on workshop program goals and target audience, that opportunity was taken to request their help with the evaluation. Two other persons, whom the author had previously met were also contacted personally. Survey packages for the remainder were sent to Mr. Carroll, who added a cover letter of his own requesting the respondent's help. It was hoped this would increase the chances of response by "connecting" the request with the Forest Service EE program, and because Mr. Carroll knew most of the individuals personally. The nine teachers were all initially contacted by Forest Service personnel (Mr. Jim Unterwegner and Mr. Earnie McDonald). Seven were sent survey packages directly, while the other two received them from Forest Service personnel who had contacted them.

All facilitator survey packages were mailed by 31 March 77. Requested return dates varied, depending on when the individual was contacted, but the latest was 25 April 77. Response by that date, however, was extremely low -- five, and a telephone follow-up was conducted from 25 April to 23 May. The problems included respondent workloads and non-arrival of survey packages. By mid June the response had increased to 19. A second follow-up was mailed out June 15th. By 1 August the response had improved to 23, and the decision was made to begin data analysis. One final response arrived in late August, boosting the total to 24.

The same procedure was followed with the teachers; seven responses were received.

4.2.3 Results and Discussion

4.2.3.1 Introduction

This section will be concerned with the results of the evaluation by both Forest Service personnel and teachers. The three major evaluation areas will be discussed separately for each lesson plan, followed by a consideration of possible relationships between background data and survey responses.

4.2.3.2 Survey Results

4.2.3.2(a) Background Information

The response rate of the Forest Service (FS) group of respondents was 68.5%. Nearly 61% of these (60.8) evaluated all three lesson plans. Of the nine teachers contacted, seven returned surveys (72.6%) and five of the seven completed all three surveys.

Although 75% (18) of the FS respondents spend 50% or less of their time in CE/EE activities, 62.5% (15) rated themselves at the high end (4,5) of the facilitator experience scale in background question #7. Only one out of 21 rated himself below a 3. Apparently the respondents regarded themselves as fairly well qualified facilitators, even though CE/EE was not a full-time job with most of them. As expected, almost all of the respondents had facilitated in a process approach workshop (91.7%) and used the technique in other situations (83.4%). A sizable minority -- 33% -- had been teachers at one time. This is considered a bonus because these people would undoubtedly draw on their teaching as well as facilitating experience when evaluating the lesson plans. Most repondents considered fires as being both frequent and a problem in the county, state, and FS region in which they lived (although this trend was much stronger on the state and regional level -- see table 4-4).

Of the seven teacher respondents, six worked with high school students and one with adults. Only four out of the seven had attended a process approach workshop. This was a surprise since it was thought

Table 4-4
Respondent's Perception of Fire

	Yes	No	Don't Know
Fires frequent in:			
County?	75% (60)*	25 (40)	0 (0)
State?	91.7 (100)	4.2 (0)	4.2 (0)
FS Region?	95.9 (83)	0 (17)	4.2 (0)
Fires a Problem in:			
County?	62.5 (40)	37.5 (60)	0 (0)
State?	87.5 (100)	8.3 (0)	4.2 (0)
FS Region?	87.5 (85.5)	8.3 (14.5)	4.2 (0)

*Percentages of teachers are given in parenthesis

that teachers with which FS EE people were in contact would most likely have been through such a workshop. Finally, the seven teachers' perceptions of fire followed the same pattern as the FS respondents (table 4-4). In addition, five of the seven teachers were forestry instructors, possibly biasing the results. For example, previous knowledge may mask information deficiencies in the lesson plans or result in a higher potential use rating than might otherwise occur with reachers involved in other areas.

4.2.3.2(b) Lesson Plan A

Section 1A, Problem Areas

Data generated by the problem area section of the evaluation survey (questions 1-6) is recorded in appendix one and presented graphically in figures 4-4 to 4-7. Mean respondent ratings for each question were used as an indicator of the magnitude of possible problems. A mean of 5 would indicate respondents saw no difficulties in the problem area concerned. A mean of 1 would indicate severe problems and a need for revision. Agreement among respondents was a second dimension of evaluation. This was indicated by the standard deviation (sd) and "clustering" of responses in figures 4-4 through 4-7. A low standard deviation and tight clustering of responses would indicate that most respondents felt similarly about the magnitude of the problem, whereas a relatively high sd and scattered responses would reveal a lack of agreement. Of most concern are response patterns where the mean is low (1,2) and the agreement is high. Of least concern are questions whose mean is high (4,5) and on which most respondents agree. A mean of 3 with high agreement is assumed to indicate adequacy (i.e. no major revisions) but room for improvement. The exception to this pattern is question two in which 3 is the desired response rather than 5.

Within the FS respondents, question 3 had both the highest mean and lowest sd (see figure 4-4a), indicating the respondents felt the tasks and discussion would meet the stated objectives.

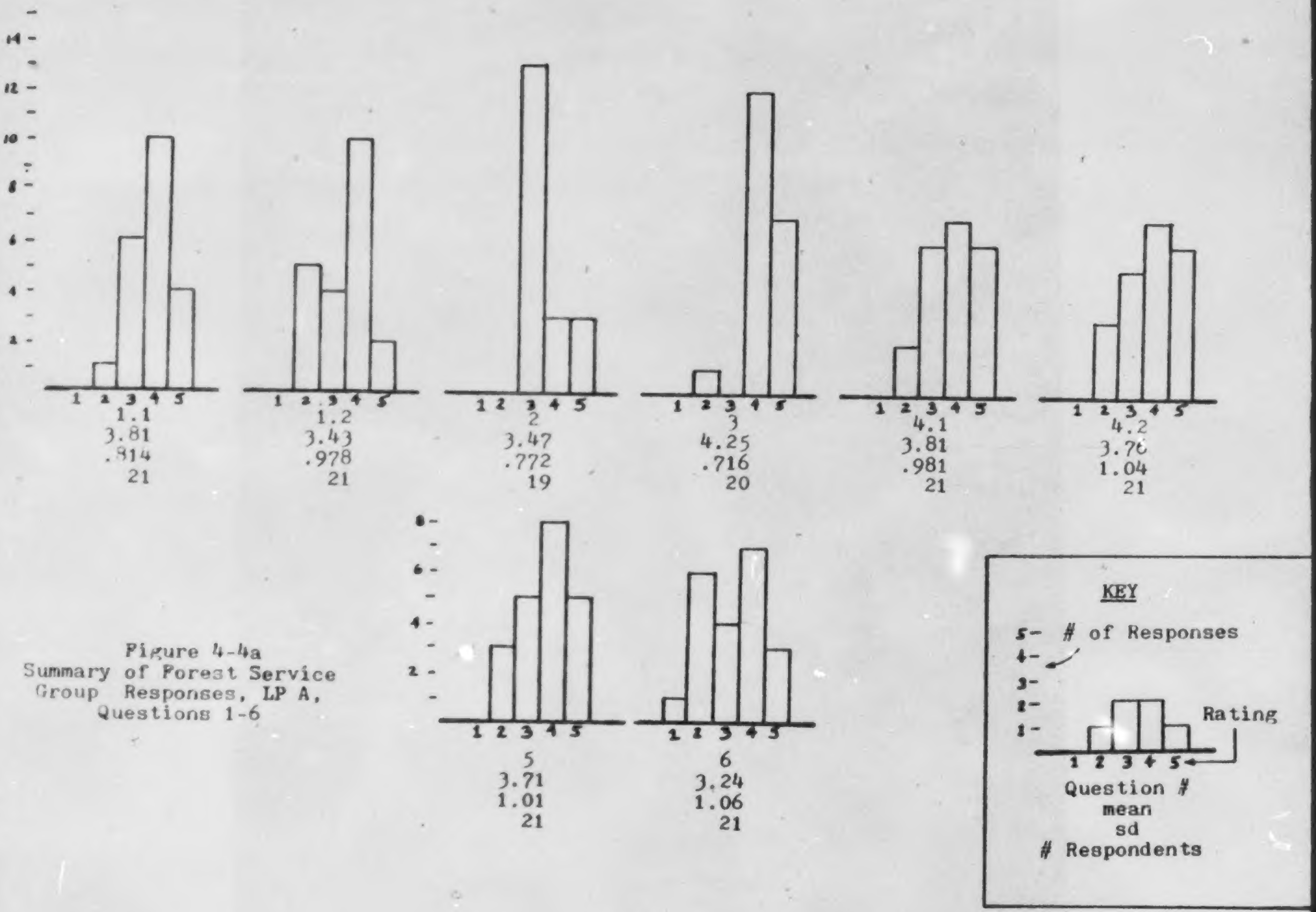
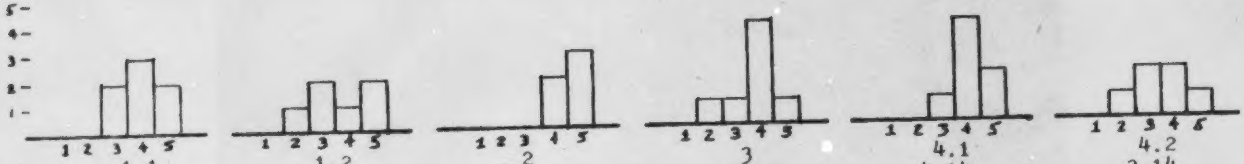


Figure 4-4a
Summary of Forest Service
Group Responses, LP A,
Questions 1-6



1.1
4
.816
7

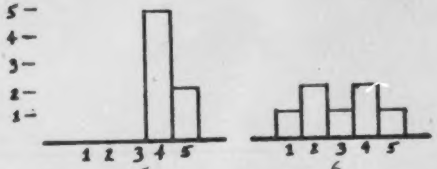
1.2
3.33
1.21
6

2
4.6
.548
5

3
3.71
.951
7

4.1
4.14
.690
7

4.2
3.14
1.35
6



5
4.28
.488
7

6
3
1.41
7

Figure 4-4b
Summary of Teacher Responses,
LP A, Questions 1-6

KEY

(See Figure 4-4a)

Agreement was also high for question 2, indicating most FS respondents thought the stated times were fairly accurate, although all responses other than 3 -- "just about right" -- were in the "too short" end of the spectrum. In addition, all of the five teachers responding rated the times as "too short" and two FS and one teacher respondent made comments expressing concern over the time frame. If anything then, the time for the tasks is underestimated.

Materials acquisition posed a problem for some respondents. Question 6.1 had both the lowest mean and highest sd of both the FS and teacher respondents. As one FS respondent and two teachers made comments indicating the fireboard was a problem in terms of acquisition, the main difficulty may lie with it. Possible alternative tasks not requiring the fireboard should be explored.

In question 6, two other questions relating to materials were included -- 6.2 regarding the adequacy of the materials required, and 6.3 asking respondents to list additional material they would like to see. The results for 6.2 are summarized in table 4-5 and indicate a great majority of respondents thought the materials required were adequate. Of the comments in response to 6.3, only two were mentioned more than once -- safety cautions (5) and a simpler fireboard (2). Although safety measures are mentioned in the lesson plan, further emphasis would not hurt. The possibility of simplifying the fireboard tasks or using alternatives not requiring the use of a fireboard has been mentioned, the former below and the latter above.

Table 4-5
Responses to Question 6.2

	FS Respondents			Teachers		
	yes	no	no opinion	yes	no	no opinion
Materials adequate instructor?						
LP A	18	1	2	7	0	0
LP B	19	0	0	4	1	0
LP C	18	0	1	6	0	0
Materials adequate participant?						
LP A	19	0	2	5	0	1
LP B	18	1	0	4	1	0
LP C	13	4	1	5	0	1

Within both respondent groups, the means for the remaining questions -- 1.1, 1.2, 4.1, 4.2, and 5 -- indicate the lesson plan is at least adequate in these areas. The range of responses though, means some improvements could be made, particularly in directions for participants (Q 1.1) where 20% of the FS responses were in the 2 category. The most complex directions in the lesson plan concern the use of the fireboard, so simplifying and/or clarifying directions there would help.

Finally, in both FS and teacher responses there is a decrease in the mean and increase in the sd from questions 1.1 to 1.2, and from 4.1 to 4.2. This pattern suggests a greater need for improvement in student rather than instructor related materials in the areas of directions and flow of information.

Section 2A, Use Potential

Table 4-6 presents a summary of the responses to the "use potential" questions (7.1, 7.2).

Table 4-6
Responses to Questions 7.1 and 72.

	FS Respondents			Teachers		
	yes	no	don't know	yes	no	don't know
Q 7.1a	18	4	-	5	1	-
b	19	2	-	7	0	-
c	18	2	-	7	0	-
d	18	2	-	6	1	-
7.2	12	1	7	6	0	0

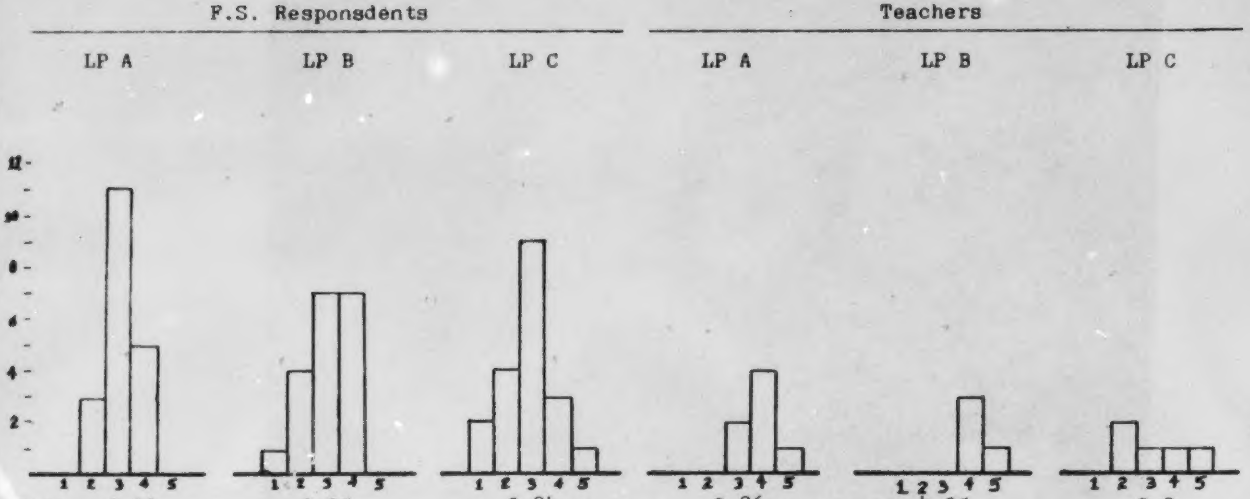
Ambiguous wording to part e of question 7.1 -- the "no use at all" alternative -- caused interpretation problems. Reactions from some respondents indicated that a "yes" or "no" response could be either positive or negative depending on how the person interpreted the question. Therefore data for part e is of little value and not presented.

A heavy majority of respondents saw the lesson plan of possible use. Fewer, although still a majority (60%) of the respondents, indicated they would actually use it in the foreseeable future (Q 7.2). Of those that responded "no" or "don't know", the single most common reason cited (4 times) for respondent doubt was unfavorable job circumstances -- workload, less contact with CE/EE. Of the six other reasons given, two involved value judgments (alternatives 7.2c and e, checked once each), three reflected difficulties within the lesson plan (alternative 7.2a and "not convenient" and "too much equipment" listed under 7.2g "other"), and one, checked twice, which could be a combination of both (alternative 7.2f). These results suggest much of the negative response would have occurred regardless of the quality of the lesson plan per se.

Figure 4-5 illustrates the "overall rating" data from question which indicates FS respondents rated LP A as on par with presently used field investigations in the workshop program. Since these field investigations are presented as examples of the process approach in action, this is regarded as a favorable rating.

Section 3A, Adaptability

Responses to question 1.1 of Part II (see table 4-8) indicate the respondents felt the lesson plans could be adapted for shorter time periods. Fewer though -- 9 -- took the time to indicate the



mean =	3.11	3.05	2.84	3.86	4.25	3.2
sd =	.658	.911	1.02	.690	.500	1.30
n =	19	19	19	7	4	5

Figure 4-5
Overall Ratings (Q8), FS Respondents and Teachers

Table 4-7
Responses to Adaptability for Shortening Question

	FS Respondents		Teachers	
	yes	no	yes	no
Adaptability for Shortening?				
LP A	16 (9)	5	6 (4)	1
LP B	17 (14)	1	4 (2)	0
LP C	12 (7)	6	5 (2)	0

Table 4-8
Task Omission Scores, FS Respondents

Lesson Plan A		Lesson Plan B		Lesson Plan C	
Task	Score	Task	Score	Task	Score
H	37	J	67	D	68
J	31	K	64	B	45
A	27	D	45	A	42
G		A	42	C	25
E	23	I	25		
B	22	B	22		
L	17	C	18		
C	16	G	14		
D		H			
I	12	E	9		
K	8	F	6		
F	0				

tasks they would omit and the order in which these tasks would be omitted. The data generated in the second half of this question was used to obtain a score for each task in each lesson plan by multiplying the number of times a task was selected as first, second, etc. choice by a value indicating its rank (9 = first choice, 8 = second choice, etc.). For example, if one task was chosen twice as first to be omitted, its score would be 2 (number of times chosen) × 9 (rank value) or 18. The results are discussed for FS respondents only, as teacher response was insufficient to establish a trend. Tasks and scores are listed from the highest to lowest in table 4-8.

Of course, because instructor time constraints and needs vary along with opinions as to relative importance of the tasks, there cannot be a universal "short" version. However, going by respondent ratings (FS), LP A could be reduced to approximately two hours by eliminating the top six tasks (H, J, A, G, B, and E). In doing so, objectives 1, 5, and 6 would also be dropped, and the fireboard task would also have to be reworked somewhat.

Table 4-9 summarizes the response of FS respondents and teachers to question 2.1. It is apparent that a large majority of respondents saw tasks within LP A that could be used independently. Nor was possible independent use confined to one or two tasks as nine of eleven FS respondents (81.8%) checked four or more tasks. Of course such results do not guarantee independent use ability -- that depends on the instructor, his objectives and situation.

Table 4-9
Responses to "Use Out of Context" Question

	FS Respondents			Teachers		
	yes	no	don't know	yes	no	don't know
Use Out of Context?						
LP A	12 (11)*	1	1	5 (5)	1	0
LP B	15 (14)	1	0	3 (1)	1	0
LPC	10 (9)	4	4	3 (2)	2	0

*Numbers in parentheses are numbers of respondents that also answered Part II of this question.

Table 4-10
Responses to "Use Out of Context" Task Rating
(Question 2 of Part II)

Task	A	B	C
A	6(55)*	8(57)	9(100)
B	8(72)	8(57)	4(44)
C	7(64)	8(57)	1(11)
D	4(37)	3(21)	5(56)
E	5(46)	7(50)	
F	5(46)	9(64)	
G	3(27)	7(50)	
H	3(27)	3(21)	
I	2(18)	7(50)	
J	2(18)	5(36)	
K	4(37)	5(36)	
L	2(18)	5(36)	
Avg.	4.3(38.8)	6.4(45.3)	5(52.8)

* # times checked/percentage. Total number of respondents completing part two were 11, 14, and 9 for LP A, B, and C respectively.

Question 2.2 of Part II was designed to identify which tasks had the greatest potential for individual use. The results (see table 4-10) show no one task receiving an overwhelming mandate.[38] There did seem to be an agreement as to which tasks had less potential. The fireboard related tasks G, H, and J were all checked by relatively few respondents. Since these tasks are preparation and follow-up activities, the weak response is understandable. Task L, also checked by relatively few respondents, depends on information gathered in previous tasks, making it less useful.

Some responses to question 2.2 point to a weakness in question construction. Instead of checking individual tasks as the question requested, two respondents grouped two or more tasks into smaller units and noted these units could be used out of context. It is possible then, that some respondents did not check some tasks because they felt each task could not be used individually, although they may have included the tasks with other tasks as groups.

Since tasks in LP A fall naturally into groups -- investigating fuel, weather, and slope influences on fire respectively -- these groups could be used independently. However, because they are narrower in scope -- investigating only one aspect of fire behavior -- their independent use potential is probably limited.

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[38] Task B was checked 72% of the time but the same task was checked only 57% of the time in the LP B evaluation.

Section 4A, Lesson Plan A Summary

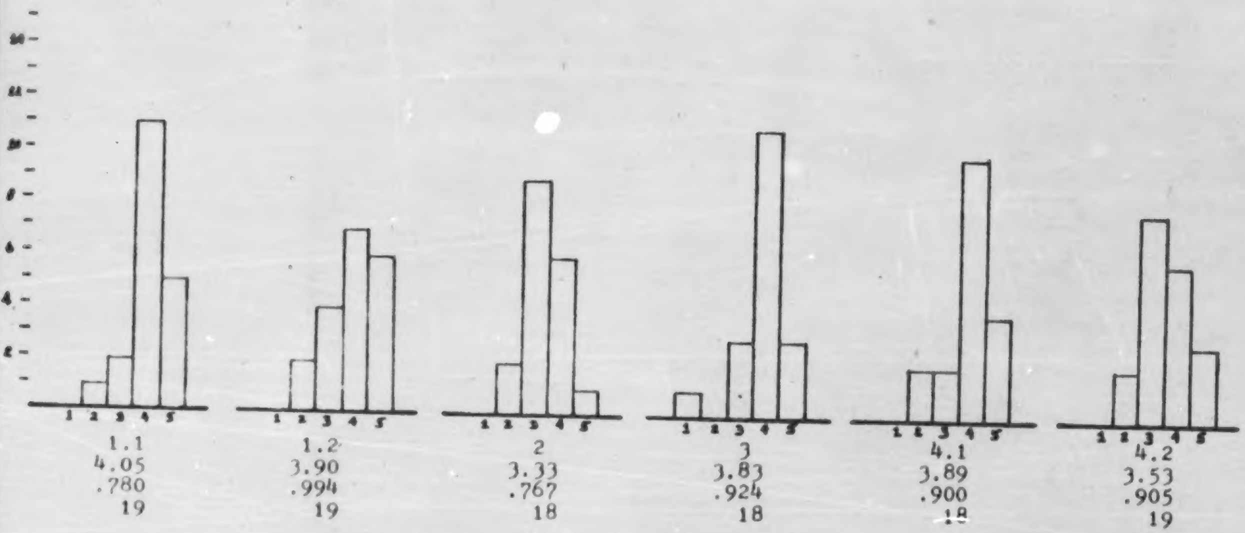
Overall, respondent reaction to LP A was favorable. All mean ratings for problem area questions were at least in the 3 to 4 range, "leaning" toward the high, no problems end of the rating scale. A majority of respondents saw the lesson plan as useable and, to a limited extent, adaptable to shorter time periods. The lesson plan also compared favorably to ones now in use in workshops.

Possible problems were identified in time frame, acquisition of fireboard materials and, to a lesser extent, clarity of directions and information flow for students.

4.2.3.2(c) Lesson Plan B

Section 1B, Problem Areas

Some of the response patterns found in LP A are also found in LP B responses (figure 4-6, a and b). The mean and relatively low sd in both FS and teacher responses for question 2, time frame estimation, suggests an underestimation of completion times as a problem. Also the drop in mean ratings from questions 1.1 to 1.2 and 4.1 to 4.2 suggest improvements be more concerned with student rather than instructor materials. In addition, the FS respondents mean for question 4.2, indicates the information flow for participants is at least adequately clear. However, the bulk of the responses (42.1%) are in the 3 category, so some improvement could be made. One respondent suggested doing the soil investigation first, then the plant and animal



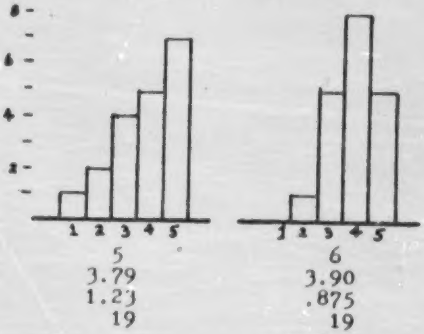
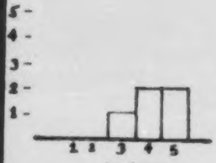


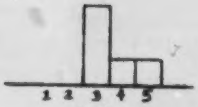
Figure 4-6a
Summary of Forest Service
Group Responses, LP B,
Questions 1-6

KEY

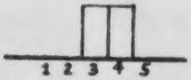
(See Figure 4-4a)



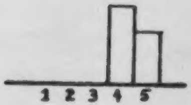
1.1
4.2
.837
5



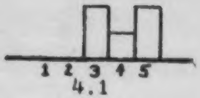
1.2
3.6
.894
5



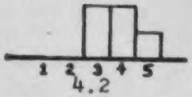
2
3.5
.577
4



3
4.4
.548
4

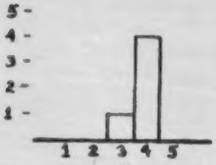


4.1
4
1.00
5

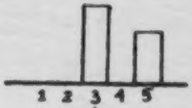


4.2
3.8
.837
5

Figure 4-6b
Summary of Teacher Responses,
LP B, Questions 1-6



5
3.8
.447
5



6
3.8
1.09
5

KEY

(See Figure 4-4a)

ones. Since fire effects on soil do impact plants (see chapter 3), this seems like a more logical progression and so may improve the information flow.

Within FS respondents the means for questions 1.1, 1.2, 4.1, 5, and 6.1 are relatively high and reflect the "leaning" of the data toward the 4 and 5 categories. Most respondents view LP B as at least adequate in these areas. If problems do exist, they would probably be in ease of use (Q 5) where 15.8% of the responses were in the 1 or 2 category.

No major problems were indicated in the areas concerned by teachers.

As with LP A, a great majority of the respondents felt the materials required by the lesson plan were adequate (see table 4-5).

Eight material additions were suggested in response to question 6.3, three of which sounded useful. One FS respondent and one teacher thought plant and animal cards could serve as examples, with the instructor and/or students making their own using local species. A note to the instructor would outline relevant plant or animal characteristics. Another suggestion was to include reproducable copies of task cards. Finally, a third suggested a brief printed explanation of the role of calcium and magnesium in plant nutrition, perhaps included on the back of the task cards.

Section 2B, Use Potential and Overall Rating

Table 4-11 summarizes the responses to the use potential questions (7.1, 7.2) for LP B.

Table 4-11
Responses to Question 7.1 and 7.2
Lesson Plan B

	FS Respondents			Teachers		
	yes	no	don't know	yes	no	don't know
Q 7.1a	13	5	-	5	0	-
b	18	1	-	4	0	-
c	18	0	-	4	0	-
d	16	0	-	4	0	-
7.2	11	1	7	3	0	0

As with LP A, a heavy majority of respondents saw LP B of possible use (7.1) while fewer (57%) indicated they would actually use it in the foreseeable future (Q 7.2). The single most common reason cited (5 times by FS respondents) for "no" or "don't know" responses was unfavorable job circumstances. Other reasons given include: no value to participants (once), prefer present investigations (once), amount of content inhibiting (once), hesitate to use "alone" -- use with other investigations (once), and don't know enough about fire (twice).[39] Again, the most prominent reason for negative responses had nothing to do with the quality of the lesson plan.

The "overall" rating data from question 8 is regarded as favorable for the same reason as given for LP A (see page 136).

Section 3B, Adaptability

The results given in table 4-7 indicate respondents felt LP B could be adapted for shorter time periods.

Based on respondent ratings, a two hour version of LP B could be produced by eliminating the top six tasks.[40] Of course, the scope of the investigation would be limited by dropping the soil investigation tasks.

Reducing LP A and B to about two hours each raises the possibility of combining the two into a single 4 hour investigation. Should this be tried, ways to save time would have to be examined closely. One possibility is to use tasks investigating environmental influences on fire (LP A, tasks C, D, F, I, K, and L), plant-fire relationships (LP B, tasks D and E), the first of the animal-fire ones (LP B, task F), and use discussion questions to explore impacts on animals further. Whatever adaptations are made, until field trials better establish the time frames for each task, the extent of time saved by eliminating tasks can only be approximated.

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[39] This was unexpectedly low as greater respondent difficulty stemming from lack of knowledge was expected. However, since most respondents worked for a land management agency (Forest Service), they may have acquired knowledge which offset informational deficiencies. However, ignorance of fire-environment relationships may still prove a barrier to more general use outside Forest Service programs.

[40] With the exception of task D. Experience with high school students suggests C would be a better task to eliminate, task D provides a better basis to do task E.

Data from question 2.1 (table 4-9) indicate a potential for independent use of tasks out of context. This is not confined to one or two tasks as 78.6% of the respondents checked four or more tasks. However, the results from question 2.2 (table 4-10) do not single out any task or tasks as having the most potential. It does, however, identify tasks respondents thought had less potential -- D (fire adaptations in plants) and H (delayed fire impacts on animals). The author can offer no explanations for the lower ratings.

Of the three lesson plans, B is probably the most adaptable to grouping (see page 141). The tasks investigating fire affects on plants, animals, and soil are actually "mini" investigations connnected by transitional discussion questions and so could be used independently. This is roughly the pattern followed by those four respondents that suggested grouping tasks.

Section 4B, Lesson Plan B Summary

As with LP A, overall respondent reaction to LP B was favorable. All mean ratings for problem areas were in the 3 to 4 range, "leaning" the responses to the high, no problem end of the scale. The lesson plan was viewed as usable by a majority of respondents, and, in a limited extent adaptable to shorter time periods. A possible shortened version was suggested. The lesson plan also compared favorably with presently established ones in use in process approach workshops.

Possible problem areas were identified in time frame, information flow, and to a lesser extent, directions.

4.2.3.2(a) Lesson Plan C

Section 1C, Problem Areas

With regard to FS respondents (see figure 4-7a), the means of questions concerning clarity of directions (1.1, 1.2) and flow of information (4.1, 4.2) indicate problems lie in those areas, particularly concerning participants where the means are lower and agreement higher. The difficulty in directions probably accounts for the lower mean rating for the "ease of use" question (5). The same pattern was evident in teacher responses (figure 4-7b), although judging from the means of questions 1.1 and 4.1 and the distribution of responses, they had less trouble with instructor directions and flow of information.

The problem with directions and information flow is also reflected in comment on the surveys. One teacher and nine FS respondents noted confusion and/or difficulty in following the lesson plan, or described it as complex. Based on these results, ways to improve

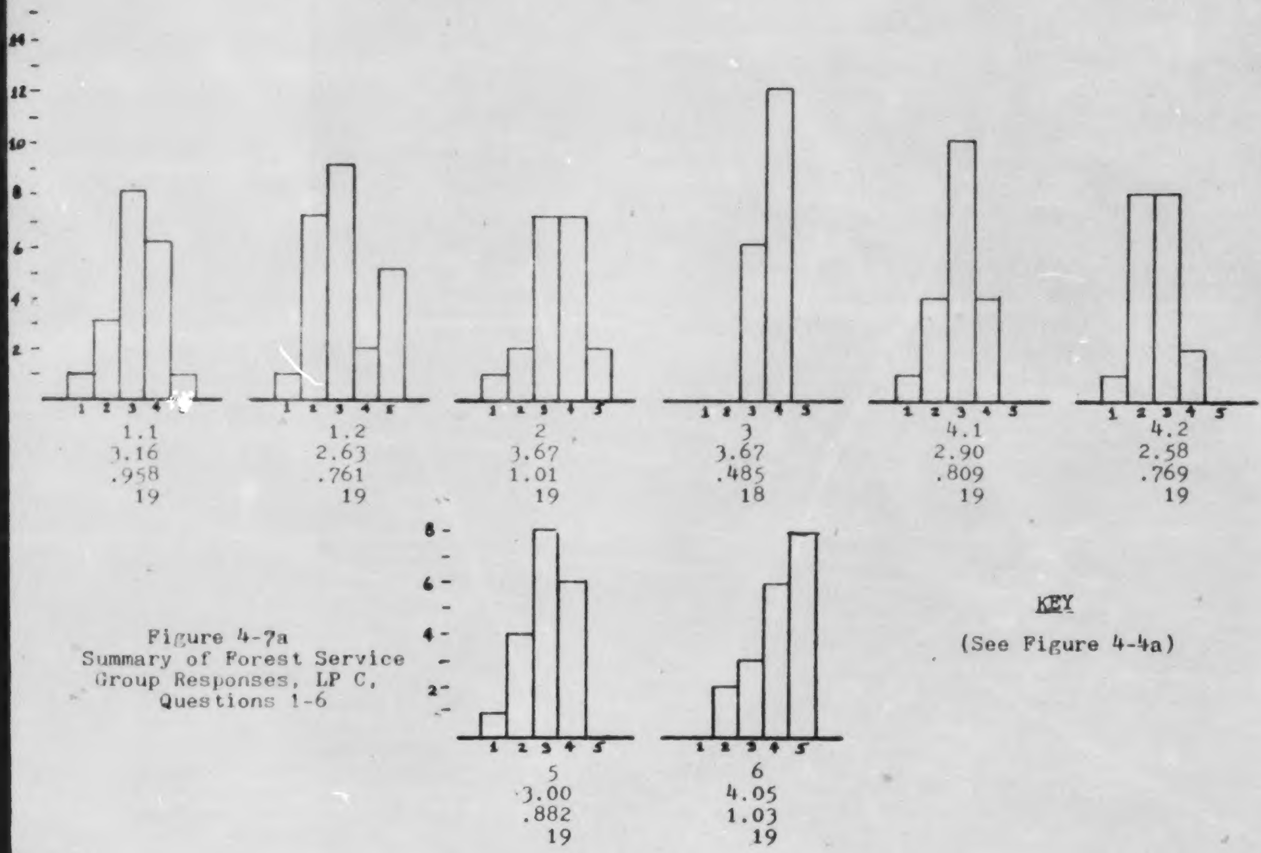
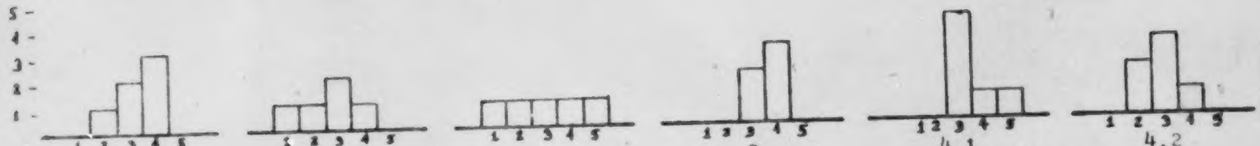


Figure 4-7a
Summary of Forest Service
Group Responses, LP C,
Questions 1-6

KEY

(See Figure 4-4a)



1.1
3.3
.816
6

1.2
2.6
1.14
5

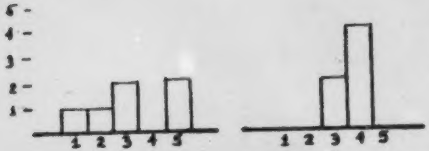
2
3.0
1.58
5

3
3.6
.548
5

4.1
3.5
.837
6

4.2
2.8
.753
6

Figure 4-7b
Summary of Teacher Responses
LP C, Questions 1-6



5
3.2
1.6

6
3.7
.516

Key

(See Figure 4-6b)

clarity of directions and information flow should be examined.

Despite difficulties with directions, the means and high agreement for question 3, accomplishing objectives, indicate both FS respondents and teachers felt the activities should accomplish the identified objectives. Responses to question 6.1, material acquisition, indicates most respondents also saw the material easy to acquire. However, five FS respondents commented to the effect that the aerial photos required in Task A might pose somewhat of a problem to obtain. Alternative tasks or questions eliminating their use would alleviate this problem. Finally, regarding FS respondents, the mean for question 2 indicates a leaning toward the "underestimation of time" side of the rating scale, although the response is spread over the 1 to 5 range.

Most respondents felt the material required by the lesson plan was adequate (see table 4-5). Six comments were made with regard to additional materials for LP C. One concerned identifying other "issue" themes. The format used in the simulation game, as developed by Mehne (1973), can be applied to any issue where a range of alternatives and interest groups are involved — something that should be pointed out to the instructor. Two other respondents thought printed copies of the rules and procedures to the simulation game would be a helpful reference for players. One teacher suggested the use of an overhead projector. This was used during a test run of the simulation game and works well if available. Finally, another thought a highway or forest map of the area concerned would be useful additional material for Task A.

Such maps could complement the aerial photographs (or replace them if necessary) and help participants better identify land uses.

Section 2C, Use Potential and Overall Rating

Table 4-12 summarizes the responses to use potential questions 7.1 and 7.2 for LP C.

Although most respondents thought the lesson plan of possible use (Q 7.1), only a minority -- 42.1% -- of FS respondents answering question 7.2 actually thought they would use it in the foreseeable future. Reasons for doubt were scattered (see table 4-13).

Table 4-12
Responses to Questions 7.1 and 7.2,
Lesson Plan C

	FS Respondents			Teachers		
	yes	no	don't know	yes	no	don't know
Q 7.1a	14	3	-	2	2	-
b	12	3	-	3	0	-
c	17	1	-	3	0	-
d	17	0	-	3	0	-
7.2	8	7	4	3	1	1

Although many of these involve value judgments (e.g. 2, 4, 6, and 7) and so cannot be resolved with revision, this lesson plan may be more limited in application than the other two, at least within

Table 4-13

Reasons Given by Respondents for "No" or "Don't Know" Responses to Question 7.2, Lesson Plan C

Reason	Number Times Given For "no"	Number Times Given For "don't know"
1. Unfavorable Circumstances	1	2
2. No value to participants/students	3	-
3. Doesn't fit into workshop or other program/curriculum	3	-
4. No room for it in workshop	1	-
5. Complicated	1	1
6. Tasks not interesting to students	1	-
7. Other topics more important	1	-
8. Too many handouts	1	-
9. Doesn't fit teaching style	1	-
10. Have to rewrite before using	1	1

the audience encompassed by the survey. However, there may be other factors at work.

Several respondents commented on the similarity between a simulation game being used in the workshop program (see appendix two) and "A Burning Issue". Actually there are some important differences:

(1) Communication. Communication in the workshop simulation game is primarily intra-group. The only time one group has contact with another is during the presentation of group plans

to the town council and a brief discussion period following it. "A Burning Issue" requires both intra- and inter-group communication. To accomplish their goals, players must communicate effectively within groups as well as between them

(2) Role Structure. Roles in "A Burning Issue" are more defined and restrictive. Players work within a value and attitude framework indicated by interest group goals that may or may not coincide with their own. Within the workshop simulation game roles are more generalized. Although player groups are asked to restrict their development plans to one land use category, within it they are free to plan according to their own value and attitude framework.

(3) Reality Constraints. In developing their plans, players in the workshop simulation game are not restricted by real world constraints. Plans have included totally underground, foolproof nuclear reactors financed by non-existent federal funds, casino's, and "houses of sin". In short, in order to "sell" their plans, players can make up whatever they think the "town council" will swallow, regardless of its connection with reality (of course, depending on one's viewpoint, this could be regarded as realistic!). Players in "A Burning Issue" are restricted to alternatives already defined for them, which have been patterned after a specific real-life situation.

Any degree of similarity between these simulation games is superficial. But if some respondents saw a greater degree of similarity, then they may have preferred the simulation game with which they were already familiar and see "A Burning Issue" as of little or no use.

Another factor that could have influenced respondent rating of usefulness is their perception of relevancy. Four FS respondents and one teacher who responded "no" made comments to the effect that "A Burning Issue" was of only limited relevance to their local circumstances. This may be true for the specifics of the situation -- the impact of fire on residential land use. However, the general situation -- a conflict between interest groups over an issue that affects land use -- probably is applicable. In such a case, "A Burning Issue" could be used as an introduction to an investigation of interest group/land use interactions on a local scale. For example, a follow-up could include identification of local interest groups (which is done in other LPC activities) and local land use or other issues, a prediction of how they would view the issue and why, and a field investigation of interest group views (e.g. via interview) to check out their predictions. The results of the field work might be of interest to local politicians. Failing that, the format can be used to investigate other issues. Lack of 100% specific situational relevancy does not totally restrict use potential.

Another relevancy related problem, indicated by one teacher's comment, is a perceived lack of relevancy to courses. Because "A Burning Issue" is not forestry, zoology, or ecology, such material is of no use in a forestry, zoology, or ecology course. There are several possible replies to this statement: (1) True, (2) Not really -- it might be desirable to extend the student's learning experience beyond forestry, zoology, or ecology once in a while, and (3) Not really -- but if segreation is deemed necessary because of time or expertise reasons, an interesting approach might be to coordinate the experiences so while students are investigating the forest-related, zoological, or ecological aspects of fire (or any other topic) in one course, they are looking into the impacts of fire on land use planning in another. The latter two would provide a broader based learning experience. However, neither of these possibilities were mentioned or suggested to the instructor in LP C.

In response to question 8 (see figure 4-7), both FS respondents and teachers rated LP C lower than the previous two lesson plans. The mean for FS responses indicated the lesson plan was thought to be slightly less effective than present field investigations, undoubtedly for the reasons discussed earlier. Agreement, however, was lower. Ratings may also have been influenced by the investigation with which it was compared. None included a simulation game. How this affected the ratings is not known. As with FS respondents, the mean of the teacher ratings was lower and responses spread out.

Section 3C, Adpatability

Two-thirds of the FS respondents and all of the teachers that completed question 1.1 of Part II thought the lesson plan could be shortened via task omission (see table 4-7). However, it is less flexible in this respect because the main activity is approximately 2 to 2-1/2 hours long.

Fewer respondents also saw tasks in LP C that could be used independently (table 4-9), although of those that did, and identified those tasks via question 1.2, 100% selected task A. This was the only task in any of the lesson plans to be selected by over 65% of the respondents.

Grouping of tasks into subunits is limited in LP C due to the small numbers of tasks involved and the domination of one activity. One possibility is to use tasks A, B, and D as a unit. Although the experiential nature of the simulation game is omitted, learners would still explore relationships between land use and interest groups, and those things that help make an interest group powerful.

Section 4C, Lesson Plan C Summary

Overall, the ratings for LP C were lower than for either LP B or A. The main problem appeared to be difficulty with clarity of directions and flow of information. Other possible problems include obtaining aerial photos for task A and underestimation of completion times. Use potential and overall ratings were undoubtedly affected by respondent difficulties with directions and flow of information. Other factors affecting use potential may have been respondents considering "A Burning Issue" very similar to the present workshop simulation game, and a perceived lack of relevance.

Respondents also saw possibilities for shortening the lesson plan and use of tasks out of context.

4.2.3.2(e) Suggestions For Improvement

The responses to part III were primarily specific ideas or comments usually noted on lesson plan copies. No attempt was made to analyze this data beyond evaluation and application of specific suggestions as they related to specific parts of the lesson plans. Some respondents also took the opportunity to make overall comments, some of which are presented in table 4-14.

One of the most negative replies has not been included in data analysis up to this point because of sketchy response to only one of the three evaluation surveys. However, an accompanying letter expressed some serious reservations. During a follow-up telephone conversation the problem areas identified in the letter were discussed further. These included the following:

(1) Variation in age/grade level of tasks. This could be a function of an assumed low knowledge level of fire-environment relationships in the audience. Given this, the learning experience starts out at a lower level and proceeds to higher ones resulting in a variation in levels of the tasks. Whether or not this is a problem remains to be seen.

(2) Some tasks may divert or mislead from intended learning. Specifically, the reviewer thought the lack of consideration

of past trends in estimating fire danger and behavior in LP A could lead to erroneous conclusions, and possible reinforcement of the bas aspects of fire if, while looking for evidence of fire (task B, LP A and B), all he finds is damage. Since predictions based on present conditions indirectly consider past trends, the latter of these possibilities is probably more serious than the former. Carrying through of bad first impressions could occur and is something with which further field testing should be concerned.

(3) Assumption of forest, brushland, and rangeland conditions atypical of Ohio (reviewer's state of residence). Although the full extent of the review's objections were not clear, concern seemed to be centered around the plant cards in LP B and the simulation game in LP C. Since creating a set of plant cards suitable for all local conditions is impossible, some restriction in existing plant cards is unavoidable. A better alternative has been considered earlier, as has the relevancy of the simulation game (see pages 145 and 156, respectively).

The reviewer also was "skeptical of the efficacy" of the lesson plans to develop a recognition of the role of fire in the natural environment. Of course, this can only be determined with more intensive field testing. However, it is possible that through these learning experiences one could develop a greater insight into fire-

Table 4-14
Selected Overall Comments

Lesson Plan A

"I would like to try out parts of this Lesson Plan. I don't know much about fire, but I know I could facilitate the tasks." (FS)

"Six hours would be needed to do this lesson plan correctly, time not available with most groups." (FS)

"Your inquiry method is really not my style of teaching but much of the material is usable and can be easily changed to fit my curriculum format. It will be very useful." (T)

"This might be a good exercise for people going into fire control, but the average teacher will find it a little too technical and too specifically related to fire behavior." (FS)

Lesson Plan B

"This is a dandy unit." (T)

"I'm concerned that you have gone above the average participants knowledge base and will cause them to lose interest." (FS)

"Really a neat investigation." (FS)

"I have mixed feelings about the lesson plan ... the idea is good but I feel further work (through trial and error) is needed." (FS)

"A real 'plus' for this lesson is the high interest level provided by including the plant and animal cards, and the imaginative tasks to do with them." (FS)

Lesson Plan C

"The game is fantastic." (FS)

"Appear to be far to complicated to use for average students." (FS)

"The simulation appears to get a little complicated, but is very interesting and -- I think -- would be effective." (FS)

"In my opinion, the relevance of this lesson plan has limited application -- it is hard to role play a situation in Wisconsin that is limited to Los Angeles or area in West and Southwest." (FS)

"This investigation is especially interesting." (FS)

"This whole lesson plan is very confusing — I do not recommend the investigation type approach for this type problem." (FS)

"This unit I'm not sure I would use, but would like to have a copy in case I need a safety valve one of these days." (T) environment-man relationships and so provide the basis for acceptance of fire as a management tool.

4.2.3.2(f) Correlation Results

A number of correlations were run between selected background information items and questions from the evaluation surveys. The purpose was two fold -- check for possible additional evidence useful in evaluating the lesson plans, and see if the respondent's view of fire was reflected in responses regarding potential or actual use of the material.

A two-tailed test was run, using Kendall's Tau, a rank order correlation method, allowing identification of both direction and magnitude of the correlation. An alpha (α) value of .025 initially used to obtain an overall significance level of .05. Those background items selected and the survey questions with which they were correlated are indicated in table 4-15. The first three background items are indicators of experience. The percentage of on-the-job time devoted to CE/EE (item a, table 4-15) sheds some light on overall experience. This is the weakest of the three since prior experience may not be reflected in present job position. Also the workshop program makes up roughly 50% of the Forest Service overall CE/EE program (Carroll, personal communication), so involvement on a lesser scale is probably limited to the workshop program. Items (b) and (c) concern past teaching (i.e. in school) and facilitator

Table 4-15
Background Items and Survey Questions Correlated

Background Question	Part I Problem Areas (Q's 1-6.1)	Part I Use Potential (Q's 7.1 a-c, 7.2, 8)	Part II Adaptability (Q's 1.1, 1.2)
a. % of job time spent in CE/EE (Q 3)	x	x	x
b. full or part time teaching (Q 4)	x*	x	x
c. self-rating of facilitator experience (Q 7)	x	x	x
d. Frequency of fire/county		x**	
e. Frequency of fire/state		x**	
f. Frequency of fire/Forest Service Region		x**	
g. Fires a problem/ county		x**	
h. Fires a problem/ state		x**	
i. Fires a problem/ Forest Service Region		x**	

*Q's 1.2 and 4.2 omitted
**Q 8 omitted

experience respectively, although the extent of the former is not considered.

Those individual correlations initially significant at the .025 level are identified in table 4-16. However, because the possibility of obtaining a significant correlation by chance alone increases the number of correlations run within a set increases, the individual α level does not remain at .025 for the set as a whole, but also increases. The magnitude of this effect was calculated using the formula $1-(1-\alpha)^c$, c = number of tests. This resulted in an overall α of .73 for the experience related correlation sets (51 tests) and .36 for fire frequency/problem sets (18 tests), far above the overall desired α of .025. Through trial and error it was found that by adjusting the individual α levels to .0005 for 51 tests and .001 for 18 tests respectively, an overall $\alpha = .025$ could be attained. At these conservative α levels only five significant -- and most reliable -- correlations remain (even doubling the overall α levels to .05 added only one more -- see table 4-16).

Based on the assumption that the judgment of more experienced people are more accurate, the results of the most reliable experience-related correlations suggest several things.

First, more experienced evaluators viewed LP B as a whole as having less potential for use as designed, possibly stemming from time frame problems. This is suggested by the negative correlation between overall experience and "use as designed" option (Q7.1a) for

Table 4-16
Correlations Significant at an Individual α Level of .025

Q #, Question		Direction and Magnitude of Correlation
3, % of job time spent in CE/EE	(A), 1,2, Directions participant	+.36505
	(B), 2, Time Frame	+.45896
	(B), 7.1a, Use as designed	-.59259(1,2)
	(B), 8, Overall rating	-.35739
	(C), 2, Time frame	+.30286
	(C), 7.1b, Use parts as designated	-.55111
	(C), 7.2, Would Use	+.32410
	(C), 8 Overall rating	+.37673
7, Self-rating of facilitator experience	(A), 3 Objectives	+.54630(1,2)
	(A), 5, Ease of use	+.58179(1,2)
	(C), 5, Ease of use	+.45675
	(C), 6.1, Material acquisition	+.48789
	(C), 7.2, Would use	+.63771(1,2)
8.1, Frequency of fire/county	(A), 7.1a, Use as designed	+.41079
	(A), 7.1b, Use parts	+.39736
	(A), 7.1d, Use as idea source	+.39441
	(B), 7.1a, Use as designed	+.44615
	(B), 7.1b, Use parts	+.39441
	(B), 7.2, Would use	+.44321
	(C), 7.1c, modify and use	+.45374
8.2, Frequency of fire/state	(A), 7.1a, Use as designed	+.32653
	(C), 7.1b, Use parts	+.53452(4)
8.3, Frequency of fire/Forest Service Region	(A), 7.1a, Use as designed	+.54772(3,4)
	(B), 7.1a, Use as designed	+.39108

1 - Significant at $\alpha = .0005$ (corrected for 51 tests to get an overall $\alpha = .025$)

2 - Significant at $\alpha = .001$ (corrected for 51 tests to get an overall $\alpha = .05$)

3 - Significant at $\alpha = .001$ (corrected for 18 tests to get an overall $\alpha = .025$)

4 - Significant at $\alpha = .003$ (corrected for 18 tests to get an overall $\alpha = .05$)

LP B, and a less reliable[41] positive correlation between time frame (Q 2) for LP B and overall experience.

Second, a need for clarifying and/or simplifying LP C procedures. The positive correlation between the "would use" item (Q 7.2) for LP C and facilitator experience indicated an increasing willingness of more experienced facilitators to use LP C. Several things may account for this. More experienced people may: (1) see more applications of the material, (2) a greater distinction between "A Burning Issue" and the simulation game presently in use, or (3) be better able to handle more complex material. Given respondent comments on the complexity of LP C, the latter is more likely. This being the case, simplifying and clarifying LP C would help less experienced people use it.

Third, the positive correlation between facilitator experience and the "achievement of objectives" question for LP A (Q 3) supports the favorable ratings this question received (see page 130).

Finally, only one reliable significant correlation emerged from the six, 18 item sets of fire frequency or problem/use potential correlations. However, even this one is of questionable value since the variation in the frequency-region question consisted of one "don't know response vs. 22 "yes" ones. Nor does lack of correlation indicate a lack of relevancy as other external (e.g. unfavorable job circumstances) and internal factors (e.g. problems with directions, etc.) can influence use potential responses. Given these problems, conclusions regarding the relationship between use potential and the presence of fire as an ecological factor are limited to a possible increase in relevancy of LP A and B in local areas where respondents saw fires as being frequent. Even this relationship is not firm since it is based on fire-frequency-on-a-county-level/use potential correlations that were not significant at the corrected individual α levels.

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[41] Because it is only significant at an uncorrected, individual α level of .025.

4.2.3.3 Simulation Game Field Test Run

The opportunity arose in late March, 1977, to field test the simulation game in LP C at Baldwinsville High School, Baldwinsville, N.Y. A teacher, Mrs. Pat Price, had expressed an interest and was willing to volunteer her unwitting 9th grade advanced biology class as guinea pigs for a test run by the author. Several meetings with Mrs. Price resulted in the following schedule.

1. 3/28 -- Homework assignment: Read Introduction, Sequence of Events, and Current State of Affairs.
2. 3/29 -- In class: Answer questions on procedures and directions.
3. 3/31 -- In class (double time period): Form groups, hand out packages with message forms and other game materials, and conduct simulation game.
4. 4/1 -- Discussion and evaluation.

The purpose of the field test was four fold: (1) Check clarity of directions, (2) Check simulation game procedures, (3) See if the simulation game produces the intended interactions among students, and (4) Check student reaction to the simulation game.

Three sources were used in evaluating the simulation game: author observations, student evaluations (via one page questionnaire), and student lab write ups.

Problems with directions were not unexpected. Converting a dynamic system of a simulation game into a static, written description is bound to cause interpretation problems. So, despite a pregame question-and-answer period on directions and procedures, several groups still had procedural questions once round one started. In fact, the entire message sending procedure and a few other basic rules had to be explained to one group. Once these questions were taken care of though, the rest of round one and the following rounds went smoothly. Responses to the evaluation survey also indicated some problems with the written directions. Two of the thirteen students that filled out questionnaires mentioned clearer explanations as one change they would recommend to improve the simulation game. In addition the average overall rating for the directions was 3.69 (1 - very hard to understand, 5 - very easy to understand), a clear indication that not everyone found the written directions totally understandable.

Students were also asked to rate the simulation game material for reading ease and understandability. The results — difficulty mean = 3.46, understandability mean = 3.68 -- suggest the reading material was slightly more difficult to read than to understand.

The time needed to add up the scores between rounds and inform the groups was underestimated. Consequently, the third round was just barely completed by the end of the second class period. Showing the students the final results had to be postponed to the beginning of the discussion period, although doing so carried a high student interest into the beginning of the discussion period.

Students saw the length of the rounds as a problem. On the evaluation survey, six (46.2%) stated the time restriction was what they liked the least. Seven (53.9%) identified more time as one change they would recommend to improve the simulation game. In the lab write-ups five (27.8%) saw the time restriction as a non-realistic aspect of the simulation game. Since simulation games attempt to simulate processes and or situations in short periods of time, time compression is unavoidable and in one sense not realistic because participants do not have the same time resources available to them as people in real life situations. However, the requirement to make decisions under time pressure (and resulting incomplete data) can be very realistic, and is an integral part of "A Burning Issue." For these reasons, time limits are necessary in the structure of the simulation game, although an extension of those limits could help. The developer of the format, Dr. Paul Mehne, found 45 minute periods worked well (Mehne, personal communication). The author feels such an extension would be most useful in the first round, giving participants a longer time to get used to procedures and get a "feel" for the simulation game. Subsequent rounds could be shortened (e.g. 35 minutes for round 2 and 25 minutes for round 3). Round length is flexible (within about a 20 - 50 minute range) and could be adjusted to user needs.

Students also commented on the method used to disclose policy point totals at the end of each round. There are two options in point total reporting. An overhead projection of the influence allocation score sheet can be used to report scores to the group as a whole. Every group knows what every other group did on each policy. The other alternative is to give groups only the total score for each policy. Players do not know who was doing what until the final report at the end of round three. The latter option was used with the knowledge that some "cheating" would occur (i.e. one group reneging on a promise to support another groups' policy in exchange for support of their own). However, the author apparently underestimated the backstabbing potential of advanced ninth grade biology students. Students commented on the amount of "cheating" during the follow-up discussion, on the evaluation surveys and, most strongly, in the lab write-ups. In the latter six students (33.3%) identified "cheating" as one of the main reasons their strategies did not work and the amount of "cheating" as not being realistic (six students also identified "cheating" as a strategy to obtain their ends!). It is interesting to note that the fact that "cheating" occurred was not regarded as unrealistic by the students, only the amount and that they were unable to determine which group(s) was (were) wielding the knife. Revealing what groups allocated how many points to which policies via the influence allocation scoresheet would discourage "cheating" in rounds one and two (the game ends after round three so no reprisals are possible). Some "cheating" is desirable because it adds another dimension to the simulation game. But too much, judging from student remarks, occurred in this case and could lead to frustration and divert from the learning experience.

The even distribution of allocation points among the interest groups drew some criticism from students. Three students (16.7%) described it as unrealistic in their lab write-ups. Such is true -- interest groups rarely have equal influence. In "A Burning Issue" equal influence is used for the sake of simplicity.

Interactions occurring in the simulation game were close to expectations. During the test run, student activity was high and fast paced. Intergroup interactions developed quickly and stayed at a high level as indicated by the constant flow of messages. In fact, the two messengers whose job was delivering messages between groups had difficulty meeting the demand for their services. Activity was also reflected in student lab write-ups. Every student described an active process of negotiation, compromise, etc. (terms varied with student). It was also evident in student responses to the "What did you like best about the simulation?" question on the evaluation survey (see below).

Student responses to "What happened in your group?" question in, the lab write-ups indicated changing intragroup interactions. Nine students (50%) described some sort of organizational process, either a division of labor or emergence of a group leader.[42] Although no attempt to do so was made, it would be interesting to compare group success in organizing with group success in passing policies they deemed desirable. Such would also be an interesting topic for the follow-up discussion.

Student reactions to the simulation game were mostly positive. When asked what they like best about it, students responded by describing essential and action-oriented aspects of the simulation game: planning strategy, working together, sending messages, competition, bargaining, etc. One student commented that "there is quite a bit to what seems like a reasonably simple problem." Another wrote he had learned "something about running a county." He did not specify what. A thirds' discoveries were more limited: He learned "how greedy some people are" -- presumably referring to some classmates.

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[42] On the other hand, one student described her group as in a state of mass confusion.

There were other more negative reactions. Two students (15.3%) described the simulation game experience as puzzling. Another found it interesting but wondered "Why do it? What is the purpose?" In addition, student interest during the post-game discussion lagged behind their interest in the game itself. Three factors could have contributed to this. First, the simulation game was "dropped in out of the blue" and was not related to their topic of study at the time -- genetics. Second, the subsequent decision by the teacher to have them write up a lab report for a grade after she had previously told them she would not do either. Three students expressed their resentment of this change in tactics. Third, an only fair job of discussion direction by the author. Based on the discussion, it is suggested that during debriefing, student responses should be recorded in some way (e.g. blackboard, overhead, etc.) to emphasize student contributions and serve as a departure point for further discussion.

In summary, the test run went very well. The simulation game generated interest and activity, and was liked by the students. Several possibilities for improvement were identified. Increasing round length, particularly in the first round would give participants more time to become acclimated to the simulation game system. Reporting what each group did on each policy would help reduce "cheating" by identifying offending groups and opening them up for reprisals. Written directions and background material need to be examined for opportunities to improve understandability and reading ease, although, with instructor back-up they were adequate in this case. Finally, post-game discussion could have been improved through the use of different discussion strategies. Of course, further field testing under a variety of conditions is needed to more fully evaluate "A Burning Issue".

4.2.3.4 Baldwinsville High School "Quasi"Field Test Program

Like the simulation game run, the "quasi" field test program at Baldwinsville High School was conceived after survey development and mailing. Its purpose was three fold: (1) test clarity of directions (2) check ability of students to handle the material, and (3) solicit student suggestions for improvement. A request was made to Mr. Coleman, principle, to be allowed to solicit volunteers from study halls. He referred the request to Mrs. Cooper in the Guidance department who obtained six volunteers. Since only three students were available during any one period (45 minutes) two groups of three students each were formed -- referred to as group A and B.

After an initial organizational meeting, the two groups of students met with the author for one period a week beginning on April 27 and running through the first week in June. With the exception of two later outside meetings, meetings were held in a small conference room in the high school.

some ways this land is being used?). Students also had little difficulty in listing interest groups in response to discussion questions between task A and B or in defining the relationships between a new land use and the interest groups (task B). They did find the directions for task B confusing. The time estimation for task B might also need to be shortened as writing in both groups had stopped after about ten minutes.

The sequence established by tasks C, D, and E of LP B was tried over a three week period. Although less certain of their responses than with task A and B above, the students were, with one exception, able to cope with the material. The exception was one non-regents program student who stated she was unable to do task C because she didn't know where to start. If a substantial number of students have this problem, an alternative would be to change the order of tasks from C, D, E, to D, E, C. Tasks D and E would help provide background for C. Another alternative would be to eliminate C.

There were also some minor definition/direction problems noted in task C. One student thought "How it produces seed" (under seed habits) was asking for the reproductive cycle of the plant. Nor was it initially clear to the students that they were to make up the plant. They suggested this be stressed in the directions. Finally, the task directions should specifically ask the learner to relate the adaptive features of their plant species to fire survival ability. One student plant design identified several features but did not relate them to fire (although the student did so in the subsequent discussion). Interestingly, in group B, two plants were designed to allow individual plant survival, while one relied on next generation survival. This distinction was made by one student during discussion.

All students were able to complete the table in task D. The number of characteristics identified ranged from two to twelve. Some were erroneous, but these were eliminated in the discussion following task D. Question four, however -- inferring fire type and occurrence from plant characteristics -- brought blank stares. Apparently this question will have to be changed or deleted. Another improvement, the students agreed, would be to identify how often the natural fires occurred.

Neither group appeared to have too much difficulty in classifying the plants as winners or losers for task E. Group B made two errors, classifying big bluestem as a loser and jack pine as a winner. Under the circumstances defined (a fire every two years) the situation would have been reversed. Further field testing would be needed to determine if this error occurs consistantly and is a problem. In addition the students thought a picture or drawing of a fire would help.

A change was made in the questions following the categorization activity. Instead of describing in writing how the community would look after 150 years, the students were asked to draw a rough sketch to help them visualize it. In group A one student stated he could not make a sketch because he couldn't picture what it would look like. This problem was solved by having him work with another student. However, the student's difficulty suggests that this activity should not be done alone, but in groups in order to alleviate possible learner frustration. In group B one student suggested a "before and after" sketch, which was done. Both groups were able to predict a community structure that reflected the openness typical of areas where fire occurs frequently (see chapter 3), although their predictions differed. Group A's rough sketch showed larger trees with a "weedy" understory, a kind of park-like situation. In group B's prediction, large trees were absent. The community was made up of grass, weeds, and low shrubs. Either prediction is plausible, depending on the severity of the initial fire, which was not defined.

Tasks J and K of LP B were tried primarily to test directions. Several problems were noted. Students in both groups were unsure of the amount of ashes or litter to use and did not know how to refilter the initial filtrate. Also students in group A had difficulty in following the directions that came with the water hardness test kit. It may be useful to rewrite directions. A late start with group A prevented discussion of their results, but group B was able to relate the increase in calcium and magnesium they found to possible increases in plant growth.

Tasks G - J of LP A, the fireboard investigation, were also tried to check directions. Since most of the students were unable to get another time period off (in fact, group A was unable to meet at all), some changes were made in the task to fit it into a single time period. Tasks G and H were eliminated. Following a brief explanation by the author of how to set up the fireboard, students started with Task I. After some initial uncertainty during which the author had to refer the students to the directions several times, they performed the tasks. Except for a problem in calculating rate, the students appeared to have little problem with the directions.

Although incomplete and limited by time and group size, the program at Baldwinsville High School did generate some useful information about the tasks tested. On the whole, the material seemed to be within the grasp of the students. Potential exceptions were noted in task C and E of LP B and one discussion question (4) following task D. Specific problems were identified in directions, definitions of terms, and background material. Suggestions for improvement were also made by several students.

It is interesting to note that many times students' verbal responses seemed hesitant or tenuous in tone. Undoubtedly some of this was due to student unfamiliarity with the topic and/or problems in the material. However, the use of a method that provides less direct instructor guidance and places less emphasis on finding the correct answer may be another factor. Students used to having answers determined for them by some outside authority would naturally be hesitant to rely on their own, particulary if the "right answer" was not obvious. Several times during the field tests students inquired about the "right answer" or "what was supposed to happen." For example, at the start of task A in LP C (listing land uses from an aerial photo) one student asked "What kinds of uses do you want?" Students also seemed temporarily confused by the author's refusal to tell them in what position to set up the fireboard.

If the educational methods presently used in high schools create student and instructor perceptions of education that make the use of the process approach (or any similar method) difficult, then a barrier might exist discouraging use. Further research might be useful to find out the extent of such a problem, if it does exist, by determining what percentage of the workshop audience is made up of high school teachers, then following up high school workshop participants to get an indication of whether they are applying process approach methods with their students.

4.3 Summary

Because fire is a dynamic and transitory force, investigating the fire-environment-man system involves looking at relationships and extending perspectives. Learners can gain insight into one aspect of the "interconnectedness" within environmental systems. Greater understanding of fire can also contribute toward acceptance of the use of fire as a management tool. The use of a learner-centered, activity-oriented method like the process approach creates the opportunity for learning on a process as well as knowledge level, plus increases in awareness and changes in attitude. The marriage of topic and method opens the way for an effective educational experience.

Development of the learning experience was done using a systematic approach. The problem was initially defined as: The development of learning experiences investigating fire-environment-man relationships using the process approach as the instructional method. Further refinement led to the identification of an audience, definition of overall goals/objectives, selection/design of an instructional strategy (in this case already selected), and the determination of a time frame. The primary audience identified was workshop participants (adults) with a secondary focus on high school students. Knowledge of fire-environment and general ecological relationships was assumed to be low. The overall goals were:

(1) To develop in the learner an understanding and awareness of environment-fire-man relationships which can be used as a basis for evaluating land management decisions in which fire is a factor.

(2) Increase learner awareness of the "interconnectedness" of environmental factors.

(3) Provide the learner the opportunity to use and develop cognitive process skills.

This was translated into the following overall objectives: Given participation in the learning experience and completion of the tasks, an environment in which fire plays a role, and the relevant characteristics of that environment, the learner will be able to: (a) generally predict and describe the likelihood of a fire (high, medium, low) and the kind that might occur, based on natural environment conditions, (b) infer the effects of such a fire on the living and nonliving parts of the environment, and (c) describe what effects periodic fires could have on land use/management. Finally, since the experiences were to be designed with possible use in Forest Service workshops in mind, a 3-1/2 - 4 hour time frame was identified.

Development began with an analysis of objectives using an adaptation of Pipe's (1966) "pyramiding objectives" procedure. This also helped identify content and processes, and establish a flow of information. Time and complexity constraints necessitated limitation of content. A variation of objectives analysis and activity development was used with regard to man-fire relationships. The decision to use a particular activity (simulation/game) was made very early in objectives analysis. Subsequent objectives and activities reflected this decision. During the period of objectives analysis and activity development, a single 4-hour time block turned out to be inadequate, so the decision was made to produce a three 3-1/2 - 4 hour lesson plans, each examining an aspect of the general topic. Development of tasks/discussion questions began at the narrowest components in the objectives analysis and built toward the larger ones. Constraints resulting from required materials were considered throughout the development process. The main guidelines were to produce investigations that did not require: (1) a burned area, and (2) special equipment not readily available through easily accessible sources, or be constructed from material that is not readily obtainable.

While in depth evaluation was beyond the scope of the study as defined, preliminary evaluation was done via survey of 24 experienced facilitators. In addition, a smaller number of teachers (7) were surveyed as the opportunity arose, the simulation game was test run in a 9th grade advanced biology class, and a selected number of tasks were "quasi" field tested with small groups of high school students. The results of the evaluation effort led to the following conclusions:

A. Problem Areas

1. Improvements in LP C should concentrate on simplifying/clarifying procedures (also increasing reading ease) for both instructor and student.
2. Any further field testing should be done with an eye on time requirements. If survey respondent suspicions of task time underestimation are confirmed, time-saving alternatives will have to be considered.
3. A simplified version of the fireboard and/or alternative tasks are not requiring its use should be explored.
4. Directions for participants/students and instructor should be simplified.
5. The possibility of additional background materials should be explored.

B. Use Potential

6. The potential for use exists in the Forest Service EE program and, to a lesser extent, high school situations.

7. The instructional method used and/or present time frame (3-1/2 - 4 hours) can be a barrier to use in school situations.

C. Adaptability

8. The lesson plans have a limited adaptability for shortening via task omission.

9. The potential exists for use of tasks out of context both individually and in groups. The choice of tasks depends on the situation and desired objectives.

In addition to seeking ways to improve the lesson plans, a major aim of the preliminary evaluation was to get an indication of the lesson plan's educational potential. Were they of possible value? The results have indicated that, at least in situations like process approach workshops where a learner-centered, experience-oriented instructional method is used, these lesson plans could be of value.

However, the extent of actual use is less certain. Parts or even all of each lesson plan may find occasional use in workshops, but they will not displace already established material. The lesson plans may also find some use in other Forest Service related activities, particularly for in-service fire-related training. Again the extent is unknown. There also seems to be potential for use in schools. However, time frame remains a problem, along with factors like teaching style, student/teacher perception of education, or perceived relevance. But whatever the case, even if these lesson plans serve only as an idea source, opening up the possibility of using fire as an educational resource in the suggested or other ways, or applying the structure and/or strategy used -- both in the individual activities or lesson plans as a whole -- to some other aspect of the environment, then the author will regard this effort as a success.

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APPENDIX ONE

Evaluation Survey Package and Summary of Survey Responses

Response totals for each option of each are located in the space provided for responses to that option, as in the example below:

Do you feel there are any tasks in this lesson plan
that could stand alone as a learning experience?

		don't
9 yes	4 no	4 know

Total number of
"yes" responses

Where response options are circled, response totals are presented above the options, as in the example below:

Is it hotter in Detroit than it is in the summer?

	2		6	4	8
	1	2	3	4	5
number of respondents selecting the option	never		sometimes		always

Mean ($\bar{x}$) and standard deviation (sd) are also presented for questions where applicable.

Where original survey questions consist of more than one part, each part has been re-numbered using a decimal system (e.g. 4, 4.1, 4.11, etc.)

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COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY

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Schools of
- Biology, Chemistry, & Ecology
- Continuing Education
- Environmental and Resource Engineering
- Environmental and Resource Management
- Landscape Architecture

Applied Forestry Research Institute
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Institute of Environmental Program Affairs
State University Polymer Research Center
U.S. Forest Service Cooperative Research Unit

CRANBERRY LAKE CAMPUS
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Charles Lathrop Pack Demonstration Forest
Cranberry Lake Biological Station

NEWCOMB CAMPUS
NEWCOMB, N. Y. 12852
Archer & Anna Huntington Wildlife Forest
Adirondack Ecological Center

TULLY CAMPUS
TULLY, N. Y. 13159
Heiberg Memorial Forest
Genetic Field Station

WANAKENA CAMPUS
WANAKENA, N. Y. 13695
Forest Technician Program

WARRENSBURG CAMPUS
WARRENSBURG, N. Y. 12885
Charles Lathrop Pack Demonstration Forest
Summer Field Program

Cover Letter for Survey Package.

We'd like your help. Enclosed are lesson plans for investigating: (A) The environment's affect on fire (the impact of weather, fuels, topography on fire); (B) Fire's affect on the environment (impact of fire on natural community development - plants, animals, soil); and (C) Land Use, fire, and interest groups (impact of fire and interest groups on land use decision making). Each lesson plan was designed to give participants some insight into a different aspect of fire and the environment. They were developed for the Forest Service by the SUNY College of Environmental Science and Forestry and are in the same format as the lesson plans in the "Investigating Your Environment"

The next step is evaluation. Because you are an experienced environmental educator, we are asking you, along with twenty-nine of your colleagues, to assess these plans (an evaluation survey is attached to the back of each lesson plan and directions attached to this letter). Because of the limited number of people reviewing these plans, we would very much like your reaction to all three. However, we are aware that your time is limited. Therefore, we ask you to evaluate them in the following priority:
. Finally, to meet our deadline, we ask you return the completed survey(s) by . A stamped and addressed envelope is enclosed for your reply.

If you would like more information on the lesson plans or the project in general, please feel free to contact Dave Reider at the return address or phone area code 315 473-8761.

Thank you very much for your time and effort.

Sincerely yours,

David L. Hanselman, Associate Professor
Environmental Education/Communications

Dave Reider
David Reider, Research Assistant
Environmental Education/Communications

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#####SURVEY DIRECTIONS##################SURVEY DIRECTIONS######

Each evaluation survey is designed to get your reaction in three areas:

1. Identification of possible problem areas with the lesson plans and estimation of use potential (Part I).
2. Adaptability of (a) the lesson plans to shorter time lengths, and (b) tasks for individual use out of context (Part II).
3. Suggestions for improvement (Part III).

We suggest you skim the evaluation survey before going through the lesson plan to get an idea of the information we are looking for. In addition, we have included a list of the main points of evaluation for your ease of reference.

The survey itself has four types of questions. In three of these, response choices are provided (yes/no, multiple choice, and ranking options, 1-5). You need only check or circle the choice that suits you. The ranking questions are designed to permit a range of opinion. For example:

Forest fires should be:	1	2	3	[✓ 4]	5
	always suppressed as quickly as possible				allowed to burn themselves out with no suppression action

In this case, the person's answer, although not agreeing with either end scale option, was much closer to the "no suppression" option than "total suppression".

The fourth type of question is open ended, allowing whatever response you think is appropriate.

****

THANKS!

MAIN POINTS OF EVALUATION

*Problem Areas and Use Potential

- clarity of directions
- estimated completion time for tasks
- lesson plan/objectives relationship
- flow of information for instructor, participant
- ease of use
- materials: easy to get? adequate?
- use potential for you: why/why not

*Adaptability

- shorter time lengths by omitting various tasks? which ones?
- individual task use? which ones?

*Suggestions for improvement

BACKGROUND INFORMATION

1. Name* ________________________

2. What grade or age bracket of students do you work with?

3. What kind of teaching strategies or methods do you employ with your students? (for example: lecture/discussion, individualized learning, inquiry or discovery experiences, etc. — please note or list in order from most common to least common)

4. Have you ever attended a Forest Service "Process Approach to Environmental Education workshop"?

___ yes ___ no

5. Are forest, brush, and/or grass fires frequent:

in the county where you live? ___ yes ___ no ___ don't know
in the state where you live? ___ yes ___ no ___ don't know
in the Forest Service region in which you live (see attached map)? ___ yes ___ no ___ don't know

6. In your opinion, are forest, brush, and/or grass fires a problem:

in the county where you live? ___ yes ___ no ___ don't know
in the state where you live? ___ yes ___ no ___ don't know
in the Forest Service region in you live (see attached map)? ___ yes ___ no ___ don't know

* Your name will only be used for administrative purposes in connection with the survey.

(A)

A LESSON PLAN FOR INVESTIGATING THE ENVIRONMENT'S AFFECT ON FIRE (FIRE BEHAVIOR)

INSTRUCTOR: Introduce the session. For example--"Today, in the next four hours we are going to make some observations and collect some data about things that influence fire in the natural environment. Then we'll use the observations we made and make some inferences about how these things influence fire and do a little fire predicting." Pass out Task A. Working alone, take about five minutes and do Task A.

TASK A

Describe the environment you are in and how you feel about it.

DISCUSSION

1. What are some environmental forces that might have produced changes in this environment?
2. What are some things we could look for that might tell us there has been a fire sometime in the past here?
3. *Instructor: Break the group into pairs and do Task B. About 10 - 15 minutes.*

TASK B Fire Find

Work in pairs.

Look for signs that might indicate there has been a fire in this environment. Use the table below as a guide:

	Browning (Scotch)	Blackening (Char)	Ash	Injury or Kill	Regrowth	Bare Soil Erosion	Other
Grass							
Bushes							
Trees:							
trunks							
leaves/ needles							
Litter*							
Soil							
Rocks							
Streams							
Wildlife (inc. insects)							
Other (list)							

What other possible signs did you see? ______________________________

*Dead and dying stuff on the ground - (leaves, twigs, branches, etc.)

DISCUSSION

1. What did you find?

2. Based on the information you have collected so far, what conclusions can you make about fire in this environment?

3. In what ways did (could) the environment affect the (a) fire?

4. What are some things that would cause one fire to be different from another?

   Instructor: There will probably be a large variety of things mentioned, but they all should fall under the major categories of weather, topography, or fuel. If one of these factors is named as a response, encourage the person to define his response further. For example, if someone says "weather" ask him/her to elaborate a little and look for things like rain, humidity, temperature, etc. Continue soliciting responses until fuel related factors have been included in the list, then focus in on that.

5. Some of the things we mentioned had to do with what was available to be burned. What are some things in the (natural) environment that will burn? *Instructor: Use the word "natural" if the module is not being done in a natural environment.*

6. *Instructor: Divide the group into small groups of two or three and do Task C. 10 - 15 minutes.*

TASK C Observing Fuels

Work in small groups (2-3)

Fuel is anything that could burn.

Pick an environment and investigate three different kinds of fuel. Think about how it smells, feels, looks, etc. Record your observations below:

	Fuel 1	Fuel 2	Fuel 3
Smell			
Feel			
Appearance			
Other Observations			

Put a small sample of each fuel in a plastic bag (1/2 to 1/3 bagful per fuel). NOTE: If you looked at a fuel that is too big to fit in a bag, use the index card in the bag and draw a quick sketch of the fuel you are investigating, along with your observations of it.

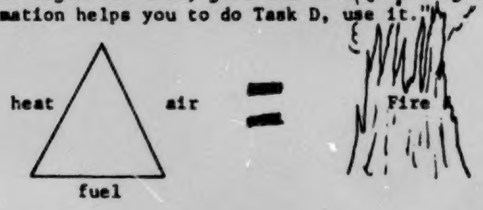
What other fuels did you see?

FB 3

DISCUSSION

1. What were some of the things you noticed about your fuels? *INSTRUCTOR: List on a large sheet of paper or blackboard. Answers can also be accepted verbally.*

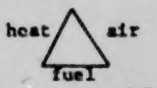
2. Using the observations you made in Task C, do Task D. *INSTRUCTOR: As the participants begin the task, give them the following information--* "If this information helps you to do Task D, use it."



As the participants are doing Task D, prepare a chart with a magic marker like below (or you can prepare it ahead of time):

Easy Burner	*Medium Burner*	*Hard Burner*

TASK D



Work in small groups (2-4).

Using the observation made in Task C and any other you can make about your fuels, classify them an easy burners (fuels you could start with a couple of matches and would burn easily), medium burners (fuels that would be harder to start and don't burn so readily), and hard burners (fuels difficult to start and keep burning).

Fuel 1 is a ________ burner because ______________________________

____

Fuel 2 is a ________ burner because ______________________________

____

Fuel 3 is a ________ burner because ______________________________

____

What were some of the things you noticed about the fuels that helped you make your decision?

DISCUSSION

1. *INSTRUCTOR: When the groups are about finished, pass out masking tape and tell the participants to post each of their bagged fuels under the appropriate column on the chart.*

2. What were some of the things you noticed about your fuels that helped you classify them as easy burners? Hard burners?
NOTE: INSTRUCTOR -- At this point, if the time and circumstances are appropriate, you may want the participants to actually try to burn their fuel samples and check out their predictions. After they have tried, ask how their predictions compare with their actual results, and reasons for similarities and differences. If the participants do try to burn their fuels, make sure proper safety precautions are taken.

3. How could you change one of the fuels you observed from an easy burner to a hard one? A hard one to an easy one?

4. What might happen in the natural environment to change a fuel from one category to another?

5. Working alone, take a few minutes and do Task E. *INSTRUCTOR: If you wish to save a little time, Task E can be dropped, or included as a verbal question.*

TASK E — Weather Changes

Work alone.

List some things you notice about weather that change.

DISCUSSION

1. What were some of the things you listed? *INSTRUCTOR: List the factors on a blackboard or large sheet of paper and number them as they are mentioned in preparation for the next task. Try to keep soliciting responses until you get a list that includes temperature, humidity, precipitation (rainfall, snow, etc.), and wind.*

2. We have generated quite a list here. Let's take a closer look at a few of these, say__________, __________, ___________, and ____________.
INSTRUCTOR: Circle or in some way mark off four weather factors listed -- The four that are most easily observed and to work with are temperature, humidity, wind, and precipitation; but others can be used. Number the factors as you name and circle them. Then break the large group into four smaller ones and give each a factor. If you have an unusually large or small group, you may want to vary the number of groups you use (or their size by varying the number of factors you use.

3. Working in small groups (2-4), take about 10 minutes and do Task F.

FB 5

TASK F Infering Weather Affects

Work in small groups. Our weather factor is ______________.

Weather can influence fire in two ways: Directly, by affecting the fire itself, or indirectly, by affecting a fuel. Try to think of as many ways as you can that your weather factor can influence fire (either directly or indirectly) in the environment.

How would it affect the fuel/fire?	Direct(affecting fire) or Indirect (affecting fuels)		Possible Reasons For Its Affect
	Direct	Indirect	

Describe an investigation you could set up at home or in your school to explore your weather factor's influence.

DISCUSSION

1. *INSTRUCTOR: Prepare a large chart duplicating the one on Task F. Tell the groups, as they finish, to post the information they have generated on the large chart. Give the people a moment to look at the chart. A time-saving option here is to share the information verbally.*

2. How does everyone feel about the information we have on the chart?

3. Using this information, what can we say about the way weather influences fire in the natural environment?

4. So far we have looked at two environmental factors influencing fire--fuels and weather. There is a third, and that is the shape of the land, or topography. What are some things you notice about the shape of the land? *INSTRUCTOR: List on paper (or board) or accept verbally. If slope is mentioned, focus in on it and do Task G. If not, introduce it. For example: "All of the things we have listed here influence a fire in one way or another. One other thing we might have mentioned is the steepness of the land or its slope."*

5. Working in small groups (3-5) do Task G. *NOTE: INSTRUCTOR--The next four tasks (G-J) make up an investigation into the effect of slope on fire. If you want to save time, you can set up the boards ahead of time (eliminating Task G) and have the grids set up (first half of Task H). If you also want to insure a variation in both rates of burning and the patterns the fires produce; predetermine the points of ignition for each board (rates and patterns will vary depending where on the slope -- if any -- the fire is ignited) and the position of each board (i.e. flat, steeply sloped, shaped like ⋀ or ⋁ . Rates and patterns will vary as slope increases or decreases.). Also be sure to review the safety precautions before you start Task J and*

watch to make sure they are carried out. A note about the fireboard: this is a piece of equipment can be constructed as is relatively inexpensively ($10 - $15). But suggested modifications that would improve it, reduce its complexity, and/or its expense are certainly welcome! The basic idea is to have some sort of rigid flat surface that a fuel can be glued or taped to, and whose slope is variable.

TASK G Fireboard Set-up for Fire and Slope Investigation

Work in small groups (3-5)

Read the instructions first!

Set up the fire board in the position you are going to investigate:

1. Open up the fireboard stand and set it up. Be sure it is standing firmly and not unbalanced.
2. Lay the fireboard (fuel side up) between the legs of the stand, so each end is resting over one of the lower threaded rods connecting the legs. If there isn't enough room between the legs for the fireboard to say flat, the space can be widened by a loosening the wing nuts and moving them out the distance needed; b sliding the legs along the rod until they are up against the wing nuts (in their new position); c threading the inside of the legs; d and tightening down the wing nuts.
3. Using the small chain, connect the hook in the center of the fireboard with the hook hanging from the top rod. To vary the position of the board, raise or lower its hinged center by changing the length of the chain suspending the board from the top rod.

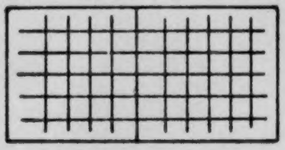
Once you have the board set up, go on to Task H.

TASK H Scaling it Down

Work in small groups (3-5)

Read the instructions first!

1. Set up a grid on the fireboard using a magic marker and a ruler. Any distance between grid lines can be used, but all lines (horizontal and vertical) should be the same distance apart. When finished, the board and fuel should look something like this:



Distance between lines ________.

2. Using the back of the task card and the ruler, make a scaled down sketch of the fireboard. Make the sketch as though the fireboard was saying flat and you were standing over it looking down on it (like the drawing in step 1). NOTE:

FB 7

To make a scaled down sketch, decide how large the scaled down drawing will be--1/2, 1/3, 1/4 the size of the original; then divide each measurement of the original (length, width, etc.) by the bottom number of the fraction. For example, it you want to make a drawing that was 1/4 the size of the original, you would divide the length, width, etc., of the original by 4; 1/3 size, divide by 3; etc. The resulting numbers are the length the measurements should be in the scaled down drawing.

	Fireboard Measurement	÷	Bottom Number of Fraction	=	Scale Measurement
A. Length	_____	÷	_______	=	______
b. Width	_____	÷	_______	=	______
C. Distance Between Grid Lines	_____	÷	_______	=	______

One inch on the fireboard = _____ inches on the scale drawing.

Use the measurements you have just calculated to draw the fireboard to scale on the back of this task card.

Go on to Task I

TASK I Igniting and Observing the Fireboard

Work in small groups (3-5). Read the instructions first! There are several jobs to do, so be sure everyone has a job. Also be sure to note the safety precautions!

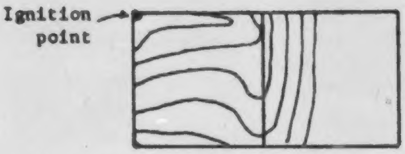
1. Pick a point on the fireboard where you want to light the fuel and note its location on your scale drawing with a large dot. *INSTRUCTOR: If you are assigning points, you will have to rephrase the task card at this point.*

Where do you predict the fire will move the fastest?

The slowest?

2. Establish a time interval you are going to use in observing the progress and relative intensity of your fire (every 5 seconds, every 10 seconds, etc.). Whatever interval you use, don't make it too long--thirty seconds for example. Why? Also, be sure to keep it constant--don't use five seconds for one interval, and ten seconds for the next. Use the scale sketch you drew on the back of the task card to make a map showing the progress of the fire by drawing an outline of the edge of the fire every ten seconds (or whatever the time interval is you are using). You can use the location of the edge of the fire on the grid lines to help you sketch in each outline on your scale drawing. After the fire has gone out and you have finished drawing the lines, label each line with the amount of time it represents. For example, if you used a ten second interval, your map

might look like this:



Time interval used _____.

Note: Your group will probably find it easier to have one person for each of the various jobs that need to be done--timekeeping, putting out burning fuel, drawing the outlines of the fire at each time interval, etc.

CAUTION! Before you go any further, be sure to have someone in the group standing by with water or some sort of fire extinguisher. Put Out immediately all burning pieces that fall off the board. Also make sure that all materials used to light the board are thoroughly extingushed before discarding! Once the board is out, be sure it is completely out, and dispose of the rest properly.

3. Light the fuel. Observe the relative intensity and progress of your fire and record your observations below and on the back of the task card (time interval line map).

	Intensity	Rate	Other
Observations			

Go on to Task J

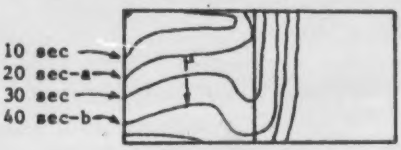
TASK J Rate Calculations Using a Scale Map

Work in small groups (3-5).

Use the time interval lines you drew on your scale drawing to calculate the rate the fire moved in three different places.

ⓐ DISTANCE - ⓑ TIME = ⓒ RATE

ⓐ Calculate the distance the fire moved in a certain period of time by measuring the distance between any two of the time interval lines on your scale map. Make your measurements at right angles to one of the time interval lines. For example, if you were going to measure a distance between time interval line a and time interval line b, be sure that the measurement is taken perpendicular to either line a or line b.



FB 9

	Distance off of Scale Map	X	Bottom Number of Fraction	=	Equivalent Distance on the Fireboard
1	___	X	___	=	___
2	___	X	___	=	___
3	___	X	___	=	___

b. Calculate the time it took the fire to cover each distance you measured by subtracting the larger number of seconds from the smaller number. For example, if you wanted to figure out the time it took the fire to cover the distance between time interval line a and line b above, subtract 20 sec from 40 sec = 20 sec. Figure a time for each distance calculated in step a.

	Time
1	___
2	___
3	___

c. Use the distance and time calculations made in a and b above to calculate the rate the fire moved over each distance.

	Distance	÷	Time	=	Rate
1	___	÷	___	=	___
2	___	÷	___	=	___
3	___	÷	___	=	___

Where did the fire move the fastest? The slowest?

What might account for the differences or similarities in your rate calculations?

DISCUSSION

1. *INSTRUCTOR: As the groups are winding up Task 3, tell them to prepare for a brief one or two minute presentation to the rest of the group on their results. Some of the things they should share are their maps showing the pattern of the fire, what position their board was in, where they lit their fire, and their rate calculations. After all the presentations are made, reassemble the group and continue the discussion.*

2. On which board did the fire move the fastest? The slowest?

3. What might account for the differences in rates of spread?

4. How would where a fire starts in the natural environment affect how fast it moves and what kind of pattern it burns in.

Introduction to Task K

1. Why would one want to be able to predict the way a fire behaves?

2. If we were to try to predict fire behavior for a particular environment, what are some things we would want to know?

3. *INSTRUCTOR: Break the group into teams of three to five and assign (or let them choose) an environment to investigate. Introduce Task K. For example: We have been looking into some things that influence fire in the environment and talking a little about what we would need to know to make a prediction about fire. Now let's do a little application. Let's take a look at an environment, make some observations, collect some data, and do a little predicting, both about the likelihood of a fire and what kind of fire could develop. Before we start on Task K though, a word about the weather instruments you will be using. The directions for their use are in with them. If you don't understand the directions, I'll be around to help you out. Be especially careful with the sling psychrometer. Make sure you look around you before you start twirling it so you don't hit anything with it!" Allow 20 - 25 minutes.*

TASK K — Getting the Facts

Work in small groups (3-5).

There are plenty of things to do here — temperature readings, relative humidity and wind measurements, fuel observations, etc. Make sure everyone has a job!

1. Briefly describe the environment you are investigating.

2. WEATHER:

Measure the relative humidity (use the sling psychrometer), temperature (ground level and four feet above the ground), and the wind speed.

Relative Humidity	Temperature Ground level	Temperature Four Feet*	Wind Speed

*Use the temperature off the dry bulb thermometer of the sling psychrometer.

What might account for any differences or similarities between the temperatures

What affect would they have on the fuels?

3. FUELS:

Note the kinds of fuel you see in your environment and what condition they are in (the information you generated in Task C and D, and on the fuel info sheet can be used as a guide.)

Draw a rough sketch generally showing the different kinds of fuels you found and their general location (on the ground, above the ground, etc.) Label or number each fuel for future reference.

What conditions did you observe in the fuels?

Fuel (label or number)	Observable Conditions

4. TOPOGRAPHY:

What is the general shape of the land in your environment?

Are there any steep slopes?

After gathering the data for Task K, go on to Task L.

TASK L Using the Facts to Make Predictions

Work in small groups (3-5).

1. Estimating fire potential:

Based on the information you have gathered about the weather, fuel, and the shape of the land, plus the material on the information sheets accompanying the task; generally estimate how easy it would be to start a fire in your environment right now.

I estimate it would be (easy, difficult, almost impossible) ____________ to start a fire in this environment using a book of matches.

Where would it be easiest to start?

What other information would have helped you?

2. Predicting what it will do once it gets started:

Based on your observations and the material on the info sheets, write a press release including a general description of the fire you would expect to occur in the environment you investigated. Consider things like

FB 12

intensity (low to high), how fast it moves (slow to rapid), where the fire is burning (in the on-the-ground fuels only, in the on-the-ground fuels and the above ground fuels, etc.).

Press Release:

Picture the fire you described in your mind. Now, on the back of the task card, sketch it in on your sketch of the fuels.

What other information would have helped you predict the fire?

What are some ways you could check your prediction?

INSTRUCTOR: Some possibilities here are checking how fires burned under similar conditions, modeling, simulations, etc.

DISCUSSION

1. *INSTRUCTOR: Have the groups share their predictions by visiting each site. The group that made the prediction should read their "press release" and explain their rationale behind it. Then ask the others how they feel about the groups press release--Was it accurate? After all the groups are finished, reassemble everyone and continue with the discussion questions.*

2. What are some things that might happen either during or before the fire that would change your prediction?

3. We have been investigating some of the things that influence a fire in the natural environment. How or where might you find these same influences at work in a city? In your own home?

4. What can we say about fire behavior as a result of our investigations today?

MATERIALS NEEDED

- Large sheets of paper (e.g. easel paper) or blackboard
- Plastic bags with index cards inside them
- Masking tape
- Fireboard with fuel (e.g. crumpled up newspaper
- Magic markers
- Rulers and large straight edges
- Clipboards or some hard writing surface for the participants
- Matches
- Watches with second hands (only if the participants are not likely to have them)
- Thermometers
- Sling psychrometers and relative humidity slide rule or table
- Wind speed gauge
- Task cards
- Flagging for marking environments (only if you preselect them

OBJECTIVES

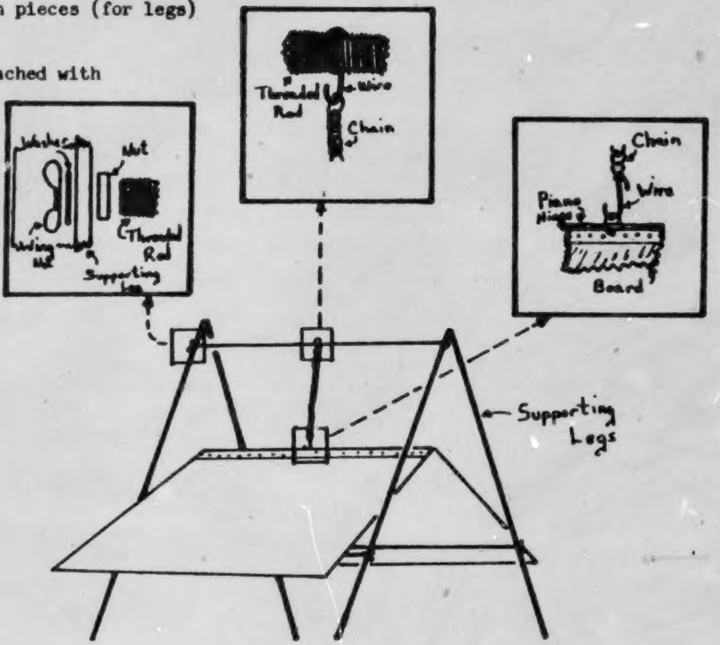
After completing this unit the participant should be able to:

1. Determine, through investigation of a particular environment, if a fire has occurred there recently.
2. Identify at least three different kinds of fuels.
3. Evaluate the relatively burnability of an environmental fuel (high/low) based on observations of that fuel; and explain the rationale behind his/her evaluation in his/her own words.
4. Identify three things in the environment that can influence fire and describe in their own words, how they affect it.
5. Construct a scale drawing after determining its size in relation to the original.
6. Calculate rate, given time and distance.
7. Generally predict the likelihood of a fire in a given area.
8. Predict and describe, in his/her own words the kind of fire that might develop in a particular environment.

FIREBOARD I

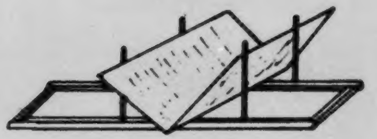
Materials

2 - 24x16 in. aluminium or plywood sheets
4 - 48 in. metal angle iron pieces (for legs)
3 - 28 in. threaded rods
1 - 24 in. chain
1 - 28 in. piano hinge (attached with rivets or bolts)
1 - clotheshanger (for wire)
2 - strap hinges
8 - nuts and bolts (for strap hinges)
6 - wing nuts (to fit threaded rods)
6 - nuts (to fit threaded rods)


Washer
Nut
Wing Nut
Threaded Rod
Supporting Leg
Threaded Rod
Wire
Chain
Chain
Wire
Piano hinge
Board
Supporting Legs

*This is the fireboard used in the lesson plan. The slope of the board is changed by shortening or lengthening the chain from which the fireboard hangs. This particular design allows the user to use almost any board slope he/she desires. Note: If a plywood board is used, be sure to cover it with tin foil before putting on fuel. See following page for simpler design.

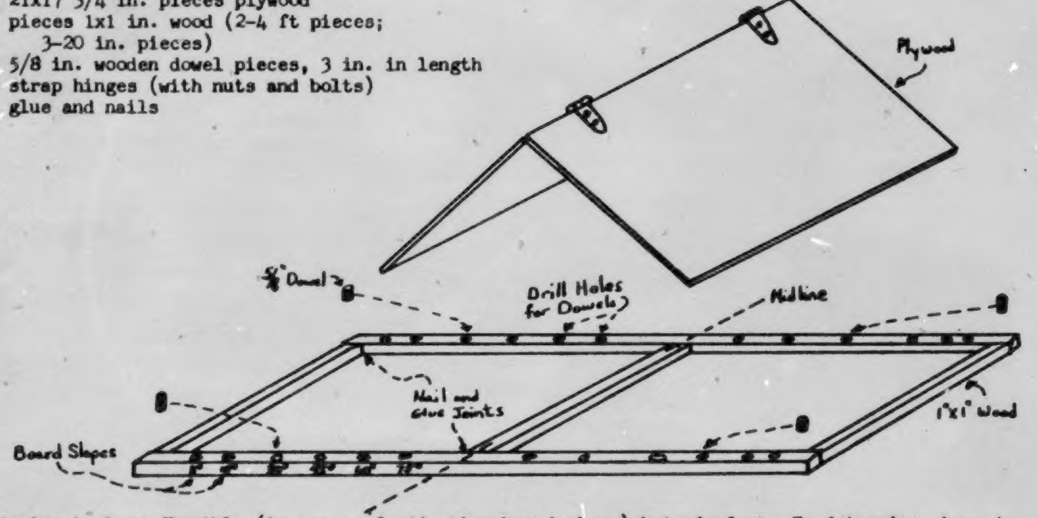
FIREBOARD II



To get "Valley" effect, turn board over and use longer dowels.

Materials

- 2 - 21x17 3/4 in. pieces plywood
- 5 - pieces 1x1 in. wood (2-4 ft pieces; 3-20 in. pieces)
- 4 - 5/8 in. wooden dowel pieces, 3 in. in length
- 2 - strap hinges (with nuts and bolts) glue and nails


Plywood
5/8" Dowel
Drill Holes (for Dowels)
Midline
Nail and Glue Joints
1"x1" Wood
Board Slopes

This design is less flexible (in terms of adjusting board slope) but simpler. To determine where to drill the holes for the various board slopes, measure the following distances from the midline: for a 5° slope, measure out 18 in.; 15° slope - 17 1/2 in.; 30° slope - 15 11/16 in.; 45° slope - 12 7/8 in.; 60° slope - 9 3/16 in.; and 75° slope - 4 15/16 in. Other distances can be calculated using the cosine relationship [Cosine of the slope angle = distance needed/17.75 (width of board)].

EVALUATION SURVEY

Forest Service
Respondents

PART I. Problem Areas and Use Potential

1. Clarity of Directions

1.1 How would you describe the directions for the instructor?

$\bar{x} = 3.81$
sd = .814

	1	6	10	4
1	2	3	4	5
very confusing and difficult to follow				very clear and easy to understand

1.2 Based on your experience, how do you think participants in a "process approach" or other workshop would find the directions?

$\bar{x} = 3.43$
sd = .978

	5	4	10	2
1	2	3	4	5
very confusing and difficult to follow				very clear and easy to understand

Comments: ____________________

2. Estimated Time Frame for Tasks

In general, do you think the stated completion time for tasks is:

$\bar{x} = 3.47$
sd = .772

		13	3	3
1	2	3	4	5
too long		just about right		too short

Comments: ____________________

3. Lesson plan/Objectives relationship (Objectives stated on the last page of the lesson plan)

$\bar{x} = 4.25$
sd = .716

Do you think the learning experiences provided by the lesson plan will result in the stated objectives being met:

	1	0	12	7
1	2	3	4	5
poorly				excellently

Comments: ____________________

4. Flow of Information

4.1 From the instructor's point of view, did you find the flow of ideas, concepts, and information:

$\bar{x} = 3.81$
sd = .981

	2	6	7	6
1	2	3	4	5
very confusing, hard to follow				very clear, easy to follow

4.2 How clear do you think participants in a "process approach" or other workshop would find the flow of information?

$\bar{x} = 3.76$
sd = 1.04

	3	5	7	6
1	2	3	4	5
very confusing hard to follow				very clear, easy to follow

Comments: ______________________________

5. Ease of Use

Assuming that the appropriate site and materials are available, do you think this lesson plan would be:

$\bar{x} = 3.71$
sd = 1.01

	3	5	8	5
1	2	3	4	5
very difficult to facilitate				very easy to facilitate

Comments: ______________________________

6. Materials

6.1 Given your present situation, would the materials required for the lesson plan:

$\bar{x} = 3.24$
sd = 1.06

1	6	4	7	3
1	2	3	4	5
be too difficult to acquire*				be very easy to acquire

6.2 In your opinion, are the materials in (or required by) the lesson plan adequate for (check one):

6.21 the instructor? 18 yes 1 no 2 no opinion
6.22 the participant? 19 yes 0 no 2 no opinion

6.3 What other materials or information (if any) would you like to see:

6.31 for the instructor? no comment = 12
comment = 7
6.32 for the participant? no comment = 14
comment = 5

Comments: ______________________________

*either by making your own or purchase.

Survey 3

7. Use Potential

7.1 Given your present situation and the materials needed, could you (answer as many as apply):

7.1 a. Use the entire lesson plan as designed. 18 yes 3 no

7.1 b. Use individual tasks or series of tasks as designed. 19 yes 1 no

7.1 c. Modify the tasks and/or discussion to suit your needs. 18 yes 1 no

7.1 d. Use it as an idea source 18 yes 1 no

7.1 e. Not use it at all 2 yes 6 no

7.2 Would you use this lesson plan (or parts of it) in the foreseeable future? 12 yes 1 no 7 don't know

If you answered "no" or "don't know", please indicate the reason(s) below: (check as many as apply)

7.2 a. I don't know enough about fire in the environment 1

7.2 b. I'm not interested in the topic. 0

7.2 c. I don't think the participants would find the topic of value to them. 1

7.2 d. I don't think the participants would find the tasks interesting. 0

7.2 e. I think other topics are more important. 1

7.2 f. It doesn't fit into the process approach workshops or other program I'm involved in. 2

7.2 g. Other: 7 comments 4 = work assignments reduce or prevent opportunity

1 = not convenient

1 = too much equipment

Comments: ____________________

8. Based on your experience as a workshop participant and/or facilitator, how would you compare, on an overall basis, this investigation lesson plan with the four presently used in the process approach workshops (Soil, Water, Forest, and Habitat)?

$\bar{x} = 3.11$
sd = .658

	3	11	5	
1	2	3	4	5
much less effective a learning experience		about as effective a learning experience		much more effective a learning experience

PART II: Adaptability

1. Adaptability for shortening.

1.1 Do you feel this lesson plan can be adapted for shorter time periods by omitting various tasks? 16 yes 5 no

1.2 Which tasks do you think would be the best to OMIT to save time. Indicate your first choice with a 1 (first omitted), your second with a 2 (second omitted), etc. If you think the task should not be omitted, leave its space blank.

Task A	18*	Task E	23	Task I	12
Task B	22	Task F	0	Task J	36
Task C	26	Task G	27	Task K	8
Task D	16	Task H	37	Task L	17

*Task omission scores, not number of respondents

2. Adaptability for Task Use Out of Context.

2.1 Do you feel there are tasks in this lesson plan that could stand alone as a learning experience? 10 yes 1 no 1 don't know

2.2 If so, which ones? (check as many as apply)

Task A	6*	Task E	5	Task I	2
Task B	8	Task F	5	Task J	2
Task C	7	Task G	3	Task K	4
Task D	4	Task H	3	Task L	2

*Number of times checked.

PART III: Suggestions for Improvement

In the space below and/or on the lesson plan itself, please make any comments or suggestions which you think would improve the effectiveness of the lesson plan; or any other comments you may have on overall content, value, style, etc.

See text.

***** THANKS FOR YOUR HELP! *****

Teachers (A) The Environment's Affect
on Fire (Fire Behavior)

EVALUATION SURVEY

PART I, Problem Areas and Use Potential

1. Clarity of Directions

1.1* How would you describe the directions for the instructor?

$\bar{x} = 4$
sd = .816

		2	3	2
1	2	3	4	5
very confusing and difficult to follow				very clear and easy to understand

1.2* Based on your experience as a teacher, how do you think your students would describe the directions on the task cards?

$\bar{x} = 3.33$
sd = 1.21

	2	1	2	1
1	2	3	4	5
very confusing and difficult to follow				very clear and easy to understand

Comments: ______________________________

2. Estimated Time Frame for Tasks

*In general, do you think the stated completion time for the tasks is:

$\bar{x} = 4.6$
sd = .548

			2	3
1	2	3	4	5
too long		just about right		too short

Comments: ______________________________

3. Lesson Plan/Objectives relationship
(Objectives stated on the last page of the lesson plan)

*Do you think the learning experiences provided by the lesson plan will result in the stated objectives being met:

$\bar{x} = 3.71$
sd = .951

	1	1	4	1
1	2	3	4	5
poorly				excellently

Comments: ______________________________

4. Flow of Information

4.1* From a teacher's point of view, did you find the flow of ideas, concepts, and information:

$\bar{x} = 3.14$
sd = .690

		1	4	2
1	2	3	4	5
very confusing, hard to follow				very clear, easy to follow

4.2* How do you think your students would find the flow of infor mation?

$\bar{x} = 3.14$
sd = 1.34

1	1	2	2	1
1	2	3	4	5
				very clear, easy to follow

Comments: ______________________________

5. Ease of Use

*Assuming that you had an appropriate site, the required materials, and the time available, do you think this lesson plan would be:

$\bar{x} = 4.286$
sd = .488

			5	2
1	2	3	4	5
very difficult for you to use				very easy for you to use

Comments: ______________________________

6. Materials

*Given your present situation, would the materials required for the lesson plan:

$\bar{x} = 3.00$
sd = 1.414

1	2	1	2	1
1	2	3	4	5
be too difficult to acquire*				be very easy to acquire

*either by making your own or purchase.

*In your opinion, are the materials (or required by) the lesson plan adequate for (check one):

the instructor? 7 yes 0 no 0 no opinion
the student? 5 yes 0 no ___ no opinion

*What other materials or information (if any) would you like to see:

for the instructor? no comment = 5
comment = 2
for the student? no comment = 3
comment = 4

Comments: ______________________________

7. Use Potential

*Given your present situation and the materials needed, could you (answer as many as apply):

a. use the entire lesson plan as designed?	4 yes	1 no
b. use individual tasks or series of tasks as designed?	7 yes	0 no
c. modify the tasks and/or discussion to suit your needs?	7 yes	0 no
d. use it as an idea source?	6 yes	1 no
e. not use it at all?	1 yes	3 no

*Would you use this lesson plan (or parts of it) in the foreseeable future?

6 yes 0 no 0 don't know

*If you answered "no" or "don't know", please indicate the reason(s) below: (check as many as apply)

I don't know enough about fire in the environment.	0
I'm not interested in the topic.	0
I think other topics are more important.	0
I don't think my students would find the tasks interesting.	1
I don't think my students would find the topic interesting.	0
I don't think my students would find it of value to them.	0
It doesn't fit into the time frame I have to work in.	0
I can't get my kids outside.	0
It doesn't fit in with the present curriculum.	0

Other: None

Comments: ______________________________

8. Based on your overall experience as a teacher, what is your overall opinion of this lesson plan as an educational learning experience for the students in the age bracket you instruct?

$\bar{x} = 3.857$
sd = .690

		2	4	1
1	2	3	4	5
poor		good		excellent

Comments: ____________________

PART II: Adaptability

1. Adaptability for shortening.

Do you feel this lesson plan can be adapted for shorter time periods (i.e. shorter than need to do the entire lesson plan) by omitting various tasks? 6 yes 1 no

*Which tasks do you think would be the best to OMIT to save time. Indicate your first choice with a 1 (first omitted), your second with a 2 (second omitted), etc. If you think the task should not be omitted, leave its space blank.

Task A	17	Task E	14	Task I	7
Task B	8	Task F	4	Task J	0
Task C	7	Task G	7	Task K	9
Task D	6	Task H	7	Task L	8

2. Adaptability for Task Use out of Context

*Do you feel there are tasks in this lesson plan that could stand alone as a learning experience? 5 yes 1 no 0 don't know

*If so, which ones? (check as many as apply)

Task A	2	Task E	1	Task I	1
Task B	1	Task F	1	Task J	1
Task C	1	Task G	1	Task K	2
Task D	1	Task H	1	Task L	0

PART III: Suggestions for Improvement

In the space below and/or on the lesson plan itself, please make any comments or suggestions which you think would improve the effectiveness of the lesson plan; or any other comments you may have on overall content, value, tyle, etc.

*****THANKS FOR YOUR HELP!*****

(B) A LESSON PLAN FOR INVESTIGATING

FIRE AND THE NATURAL ENVIRONMENT

INSTRUCTOR: Set the stage for the investigation by telling the participants what they are going to be doing. For example: "During the course of these investigations we are going to develop some skill in making observations and collecting data about fire and the living and non-living parts of the environment. Then we'll use the data and observations to make some inferences and predictions about how fire affects the environment and some of the changes it produces. Pass out Task A. Working alone, take about three or four minutes and do Task A.

TASK A

Describe the environment you are in. How do you feel about it?

DISCUSSION

1. What are some environmental forces that might have produced changes in this environment?
2. What are some things we could look for that might tell us there has been a fire sometime in the past here?
3. *INSTRUCTOR: Break the group into pairs and do Task B. About 10-20 min.*

TASK B Fire Find

Work in pairs.

Look for signs that might indicate there has been a fire in this environment. If the table below helps, use it.

	Browning	Blackening (Char)	Ash	Injury or Kill	Regrowth	Bare Soil/ Erosion	Other
Grass							
Bushes							
Trees:							
trunks							
leaves/ needles							
Litter*							
Soil							
Rocks							
Streams							
Wildlife (inc. insects)							
Other							

What other possible signs did you see?

*Dead and dying material on the ground (leaves, twigs, branches, etc.)

DISCUSSION

1. What did you find?

2. Based on the information you have collected so far, what conclusions can you make about fire in this environment?

3. What are some ways that fire could affect this environment?

4. How could a fire affect the plants in this environment?

5. What changes might happen in the plants of this environment if a fire occurred here, say every two years?

6. Working alone, do Task C. Take about 5 - 10 min.

TASK C

Plant-geneering

Think about how a plant species might adapt itself to fit in an environment where fires occur regularly. Considering things like the way it produces seed, the kind of seed it produces, how it is spread, the needs of the young plants and the physical characteristics of the mature ones; design a "fire plant." Describe your plant and draw a sketch of it highlighting the adaptive features you've given it.

Sketch

Seed Habits (How it produces seed, how it spreads it, etc.):

The needs of the young plants:

Physical characteristics (bark, leaves, roots, stems, etc.):

Briefly describe the fire you pictured in your mind when you designed your plant.

DISCUSSION

1. *INSTRUCTOR: Have some people share their designs. Note: look for characteristics that would help an individual plant to survive (thick; fire resistant bark; fire resistant foliage; heat tolerance; regrowth from underground rootstocks, buds or stems) versus those that help maintain the the species by insuring the next generation with special reproductive adaptations (wind-borne seeds; fire and heat tolerant seeds; cones and other seed-holding mechanisms that protect seeds and release them after a fire; sun-loving young plants that take advantage of open areas left after a fire; etc.). If these different types occur, relate one the the other--for example: "How does your plant design compare to Andy's?"*

2. You've all designed some pretty imaginative fire plants. It may surprise you--or it may not--to know that plants adapted to regualr fires occur in many areas of the country. Many of them have characteristics very much like what you have designed into your plants. Using these plant cards - INSTRUCTOR: *Pass out the plant cards, one to each group* - break into small groups, and do Task D. Take 10 to 15 minutes.

TASK D

Work in small groups (2-5). Our committee's plant is _________.

Suppose for a moment, that you are an advisory committee to a Land Management Agency of this state. You are trying to decide whether or not to introduce this plant species to new areas of the state. So far, the environmental conditions you have looked at seem suitable for it. But because the area you are considering has a history of natural fires* occurring regularly, you now have to decide whether or not this plant species could thrive (or even survive) in an environment where fire is a factor -- you don't want to commit the state to spending money on a planting program that would be doomed to failure. What are some characteristics of the plant species that might tell you something about its ability to live and thrive in an area where fires occur regularly.

Characteristic	Would the characteristic help or hurt its chances?	How would it help or hurt

It is the opinion of this committee that the regular occurrence of fire in an environment where _________________(plant species) was growing would tend to (encourage, have no effect, eliminate) _________________ it because

What are some ways you could check your decision?

*INSTRUCTOR NOTE: *For this task a helpful accessory is a photograph or drawing of a fire (i.e. ground fire, crown fire, or whatever is available to use). If that is not available, it may be helpful to have each group describe the kind of fire they think it will be.*

DISCUSSION

1. What were some of the characteristics you listed. INSTRUCTOR: *You can accept the responses verbally or list them on a large sheet of paper or a blackboard. If you list them, refer to the list during the following discussion.*

2. Which would help the individual plant itself to survive?

3. Which might not help the individual plant, but preserve the species by helping to insure future generations?

4. What could these characteristics tell us about the occurrence and type of fire in a plant environment?

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Characteristic	Would the characteristic help or hurt its chances?	How would it help or hurt

It is the opinion of this committee that the regular occurrence of fire in an environment where ________________(plant species) was growing would tend to (encourage, have no effect, eliminate) ________________ it because

What are some ways you could check your decision?

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DISCUSSION

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2. Which would help the individual plant itself to survive?

3. Which might not help the individual plant, but preserve the species by helping to insure future generations?

4. What could these characteristics tell us about the occurrence and type of fire in a plant environment?

5. Your committee has just looked into the relationship between one plant and one environmental influence, fire. In the natural environment, though, more than one kind of plant is usually found in one area. Form a plant community by getting into groups of five*, each with a different plant card, and do Task E. Take 10 - 15 min. *INSTRUCTOR: *Size of the large group will cause a variation in the size of the smaller groups. One way to divide the group up is by numbering the cards for each plant, 1, 2, 3, 4, etc., to however many you use (depending on group size in Task D). When you are ready to go on to Task E, have all the "ones" get together (people with plant cards numbered one.), all the "twos" etc.*

TASK E **Winners and Losers**

Work in small groups (2-5).

Any time a natural force acts on a plant community there are winners (plants that benefit) and losers (plants that are hurt by the force itself or by the changes it produces). Use the information from Task D (and on the plant cards) and generally list the winners and losers in your community from the biggest winner to the biggest loser (in order) if a fire occurred in your community's environment every two years for 150 years.

Winners

Kinds of Plants

Losers

Consider:

1. The adaptations of the plants
2. The conditions left by the fire and the needs each kind of plant has to successfully reproduce.
3. The frequency of fire and the vulnerability of the young and mature plants.

Which plants would you expect to find in your community after 150 years?

What do you see your community looking like (physical appearance) after 150 years?

How is it different from the appearance of the community you started out with?

DISCUSSION

1. *INSTRUCTOR: While the participants are doing Task E (or beforehand) prepare a ranking chart on a large piece of paper or blackboard similar to the one in task. When the participants finish, ask "How did you rank your plants" and as they respond list on the paper. When you get a list developed, check with the group to make sure everyone agrees with it.*

2. What did you see your community looking like after 150 years?

3. What things would have been different if the fire occurred every 80 years for say, 400 years instead of every 2 years? If no fire occurred at all?

4. What can we say about the way fire, or its absence, can affect the make-up and development of plant communities?

5. What are some ways changes in the plant community could affect the animals?

FIRE AND ANIMALS

DISCUSSION

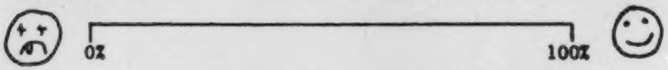
1. What are some animals you would expect to find in this environment?
   INSTRUCTOR: If this unit immediately follows the Fire and Plant one (above) this question can be dropped and the discussion continued with question 2.

2. What are some ways a fire could affect these animals?
   INSTRUCTOR: Again, if you are continuing the discussion from the Fire and Plant unit (above), you might want to use the following question instead: "What are some other ways fire could affect animals in this environment?" Focus in on direct fire affects (e.g. fire kill or injury of wildlife, etc.). If it isn't mentioned, introduce it. For example: "Let's take a closer look at one or two of the direct ways fire can affect wildlife that we've mentioned--fire kill and injury for example. Working alone or in pairs, pick one of the animal cards and evaluate your animals response to this kind of fire." Show a picture or sketch of a fire, or read a description of one. A ground fire works the best. An option here is to have the participants put themselves in place of the animal. Introducing the task might be done in this way: "Pick one of the animal cards and put yourself in the place of the animal. Try to see out of its eyes. You have been up for a couple of hours and are just beginning to poke around for something to eat, when suddenly you smell smoke. Then you see the fire." Show the photo or read the description. Then tell the group to take about five minutes and do task F.

TASK F Crispy Critters?

Work in pairs or small groups. Our animal is ____________.

How do you rate your animal's chances of surviving the fire?



We rate our animals chance of survival about ________ because

DISCUSSION

1. How did you rate your animal's chances of survival?
   INSTRUCTOR: You can accept answers verbally or, if you wish, list each animal and its rating as it is mentioned on a large sheet of paper or blackboard. As ratings for different animals are repeated (which they

will be if a limited number of animal cards are used), post the second and successive figures next to the first ones. If the figures differ greatly inquire about the reasons for the ratings and the difference.

2. *INSTRUCTOR: Tell the group all their animals survived and introduce Task G. For example: "I have some good news and bad news for you. First the good news--your animals are one of the lucky ones of their kind that escaped the fire without injury. But--and now the bad news--they all have to get back to the business of making a living in their environment. Continue on and do Task G. NOTE: At this point you can, as an option, ask if there was anyone who rated their animal's chances at 0%. If some answer yes, you may have them "cash in" their animal card for a different one or work with someone else. Another option is to form larger groups by putting all the people with the same animals together to do Task G. 15-20 minutes*

TASK G

Work in pairs or in small groups (3-5).

1. After your animals narrow escape, it returns to the area it calls home only to find the fire has past through it. What changes in the environment might it find?

2. Once back, despite the changes, your animal still has to find things to meet its basic needs--food, water, and cover (places where it goes to escape enemies, bad weather, or special places it needs to raise its young). How do you think the changes the fire made affect its ability to "make a living?" Use the scale below if it will help:

1	2	3	4	5
definitely help out	make life a little easier	have no effect	cause some small problems but nothing your animal can't handle	Cause very serious problems that you doubt your animal will be able to handle

Immediately after the fire:

	Rating	Reason for Rating
Food		
Cover		
Water		

What might be your animal's reaction to the changes in his/her environment?

DISCUSSION

1. What changes did you see happening?
2. How did these changes affect your animals ability to "make a living?"
3. How might your animals environment keep changing after the fire?
4. *INSTRUCTOR: Introduce Task H. For example: "Well, let's reevaluate the livability of your animals environment a year later." Note: The responses to question 3 will vary widely, depending on the area of the country, the time of the year, and the severity of the fire used as the example. Also, some people may feel they would not be able to survive in the fire altered environment. You may want to ask if there are any of these "ecological losers". If so, you can ask what they would do or what would happen to them. After they respond, have them work with another group or chose another animal.*

TASK H

Work in small groups (2-5). Animal _______________

A year has past since the fire. Thinking about some of the fire-related changes that have happening, how do you rate the livability of your animals environment now? Use the same rating system as in Task G.

	Rating	Same as or Different from Task G Rating	Reason(s) for the Similarity or Difference
Food			
Cover			
Water			

DISCUSSION

1. What differences or similarities did you think you might find in your animals environment a year later?
2. How could these changes help your animal "make a living?"
3. What are some ways fire could be used as a tool in managing wildlife?
4. What can we say about fire and wildlife as a result of our investigations today?

FIRE AND SOIL

DISCUSSION

1. So far we have investigated relationships between fire and the living part of this environment. There are also many non-living parts of the environment, one of which is the stuff we are sitting (standing) on, the soil. Form small groups, take about 10 - 20 min and do Task I.

TASK I **Digging for data**

Work in small groups (2-4)

Pick a spot in this environment and, using the small shovel, dig a hole about a foot deep. Use the side of the hole to make observations about the soil. What are some things you notice?

Observations

1\.

2\.

3\.

DISCUSSION

1. What were some things you noticed about the soil. INSTRUCTOR: *An option here is to list the things mentioned on a large sheet of paper or blackboard.*
2. Which of these things do you think a fire could affect? INSTRUCTOR: *If you have listed the responses above, indicate which ones the group agrees will be affected by fire by marking them off.*
3. How might a fire affect __________? INSTRUCTOR: *Pick one as an example. Given the time and the opportunity, an option here is, after the participants have finished discussion the question, pick another one of the things on the list and design (and possibly do) an investigation into how fire would affect it.*
4. What are some other soil characteristics we haven't mentioned here? *Note: Some examples might be pH, fertility, soil nutrients, drainage, erodability. If soil nutrients or fertility are mentioned, to on to Task J. If not introduce it. For example: "One other soil characteristic we could add to this list might be its fertility."*
5. Form small groups, take about 20 min. and do Task J.

F & t.
9

TASK J Determining Soil Nutrients

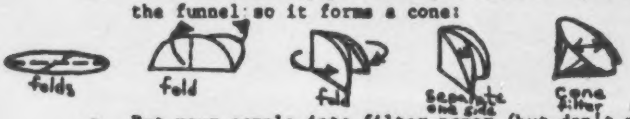
Work in small groups (2-5).

The fertility of a soil depends on the amount of plant nutrients available for the plants use in it. Two of these nutrients are Calcium and Magnesium.

Using the water test kit, measure the amount of Calcium and Magnesium in a sample of the topmost layer of the soil. Using the procedure below, test for Calcium and Magnesium.

a. Test the distilled water you will be using with the water test kit. Directions on its use are inside it.

b. Fold the filter paper into quarters, and put it into the funnel so it forms a cone:



c. Put your sample into filter paper (but don't pile it above the cone formed by the filter paper.). Set the funnel into the glass jar, cup, or whatever glass container you are going to use to catch the water as it filters through the sample.

d. Pour a measured amount of the distilled water over the sample. (50 milliliters works well, but whatever you use, don't use too much--why?). What might be the reason for using distilled water?

e. When the water is finished filtering through, pour it back over the sample and filter it again.

f. When the water is finished filtering through a second time, test it for Calcium and Magnesium by using the water test kit. NOTE: Before you do the actual test, use a little of the filtrate to rinse out the test vial in the kit you are going to use.

	Total Hardness (Calcium + Magnesium) -	Calcium =	Magnesium
Distilled Water			
Top Layer of Soil			

When you are finished, post your results on the large chart.

DISCUSSION

1. How might a fire affect the nutrients you found in the top layer of the soil?

2. Take about 15 minutes and do Task K. Use these ash samples.
INSTRUCTOR: To do Task K, you will need to make some ash samples ahead of time.

One way to do this is to collect litter samples a couple of days in advance of the investigation, allow them to dry (either by just setting them out in the air or putting them in an oven), and burning them on a cookie sheet or some other fireproof surface. After the ashes cool, put enough in each plastic bag to fill the cone formed by the filter paper. One type of litter can be used (e.g. pine needles) or a variety. If only one type is used try to be sure it is pretty much the same type the students will be collecting in Task J. If a variety is used, you may want to label what kind of litter it was (pine needles, hardwood leaves, dead grass, etc.) for possible comparisons. A variety may be desirable if different groups in Task J collect different types of litter.

TASK K

Work in small groups.

Using the procedure you used in Task I, test the ashes for Calcium and Magnesium. NOTE: Before you use the funnel and glass jar, rinse them both with distilled water. Why?

	Total Hardness (Calcium + Magnesium) -	Calcium =	Magnesium
Distilled Water			
Top Layer of Soil			
Ashes			

When you are finished post your results on the large chart.

DISCUSSION

1. What similarities or differences do you notice about the data we have collected?
2. What might account for the (increase/decrease) in the nutrients in the ashes? NOTE: *Most of the data should show an increase.*
3. What effects could this (increase/decrease) have on the plants and animals?
4. What can we say about the effect fire has on the soil?
5. What are some other non-living parts of the environment fire could affect? INSTRUCTOR: *At this point, the following task is optional*

TASK L

Work alone or in small groups.

Design an investigation into fire's effect on one of the other non-living parts of the environment you could do at home/in school.

8. As a result of our investigations today, what can we say about fire and the natural environment?

MATERIALS NEEDED

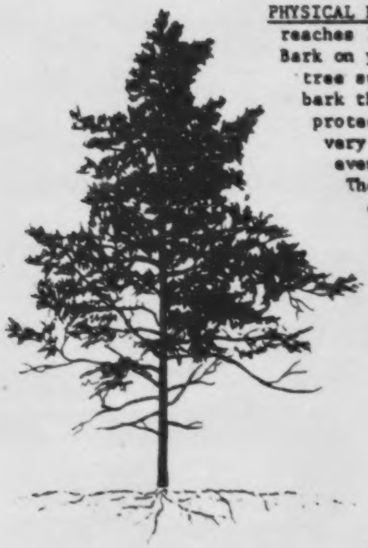
- -Large sheets of paper (e.g. easel paper) or blackboard
- -Plant cards
- -Photo or sketch of fire and aftermath
- -Animal cards
- -Shovels or trowels
- -Filter paper
- -Funnels
- -Distilled Water
- -Hardness water test kit (Calcium and Magnesium)
- -Ashes from burned litter
- -Clipboards or some sort of hard writing surface for participants
- -Magic markers

OBJECTIVES

After completing this unit the participant should be able to:

1. Determine, for a given area, if a fire has occurred recently.
2. Identify at least two plant adaptations to fire and determine whether they would help the plant itself to survive or insure a next generation.
3. Infer the presence or absence of fire as an environmental influence from the characteristics of the common plants of a particular environment.
4. Identify at least three ways fire can affect wildlife.
5. Predict the susceptability of an animal to fire, given its characteristics.
6. Identify at least two non-living parts of the environment and describe in his/her own words how fire could effect it.
7. Use the water test kit to determine the calcium and magnesium content of litter and ashes.

HEMLOCK



PHYSICAL DESCRIPTION: Hemlock is a coniferous tree that reaches 100 feet in height and lives about 250 to 300 years. Bark on younger trees is flakey, scaly, and thin, making the tree susceptible to damage. As the tree gets older, the bark thickens to about two or three inches, giving more protection. Because is is shade tolerant, it will grow very slowly under the shade of a forest canopy, but eventually work its way up into the canopy and the sun. The root system is widespreading but shallow and easily injured by environmental disturbances.

SEEDS: Small and winged, spread by the wind. Seeds mature in cones over the summer and are shed over fall and winter. Trees begin producing cones when anywhere from 20-50 years old, but densely shaded trees do not produce cones.

SEEDLINGS: Survival best on shaded, moist, cool sites, especially on decomposing leaves and twigs on the forest floor. They are occasionally found on old rotting stumps and logs. Bare soil or exposed sites are not good because the tiny seedlings can be washed out or buried in the mud in heavy rains. Older seedlings can survive with as little as 5% full sunlight. Too much sunlight can cause heat injury or dry out the soil, killing the seedling.

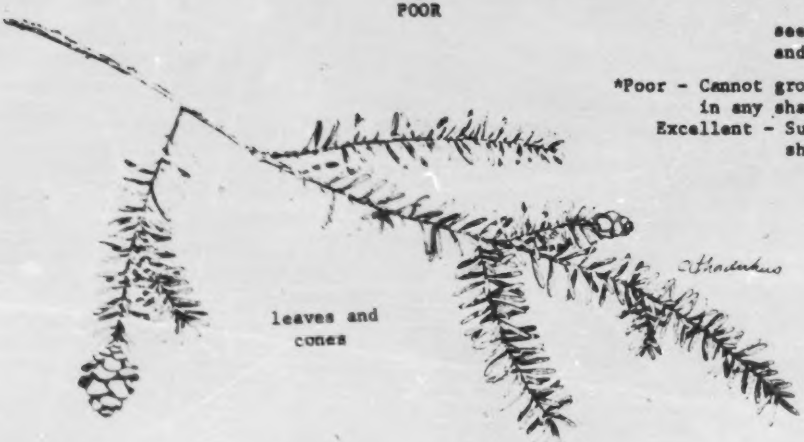
SPROUTING: Hemlock does not sprout naturally.

*TOLERANCE OF SHADE:

POOR — ▲ EXCELLENT

seedlings and trees

*Poor - Cannot grow or survive in in any shade
Excellent - Survives in very shaded conditions



leaves and cones

SUMAC

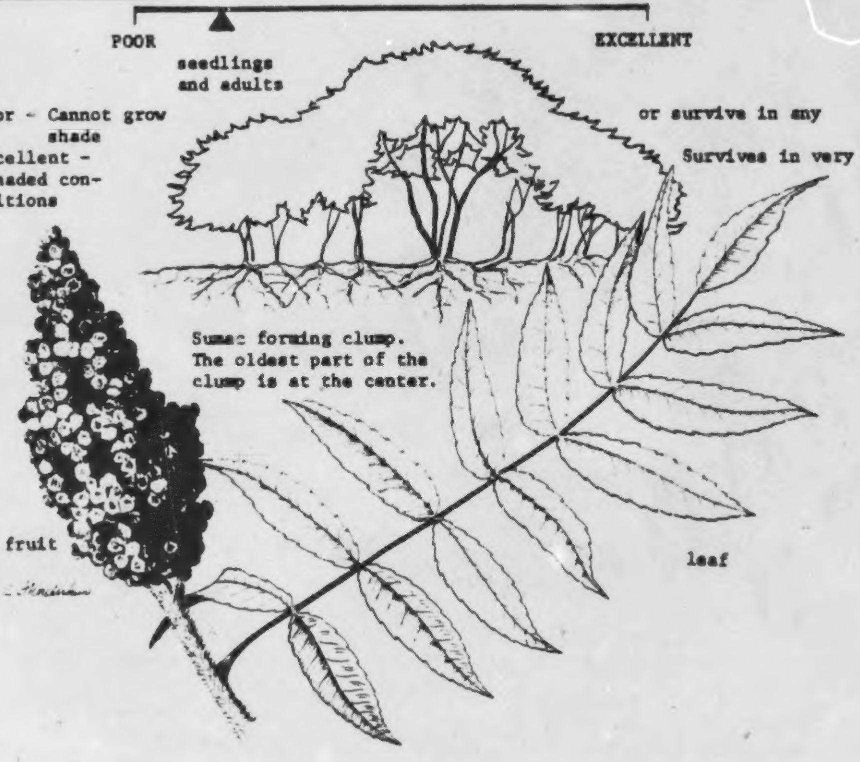
PHYSICAL DESCRIPTION: Sumac is a shrub or small tree, ranging anywhere from 6 to 30 feet tall and usually grows in clumps. It is easily identified in the summer and fall by upright clusters of berry-like fruit that turn bright red as the summer fades. Bark is smooth and very thin. The root system is shallow and spreading.

SEEDS: Seeds are small with a hard coating and contained in fruits (like grapes or blueberries). Scraping or abrasion of the seeds helps germination. Usually this is done by passage through the digestive system of animals after they have eaten the fruit. Sumac seed is spread to new areas by wildlife who leave the seeds in their droppings.

SEEDLINGS: Seedlings need open sunny areas to get started, without too much competion.

SPROUTING: Once established by seed, sumac spreads outward in a roughly circular pattern by sprouting from the roots, forming circular clumps. It also sprouts when above ground part of the plant has been killed or cut down.

*TOLERANCE OF SHADE:

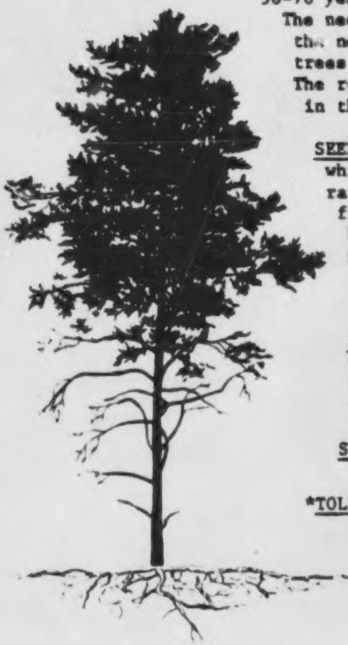


Sumac forming clump. The oldest part of the clump is at the center.

*Poor - Cannot grow or survive in any shade

Excellent - Survives in very shaded conditions

JACK PINE



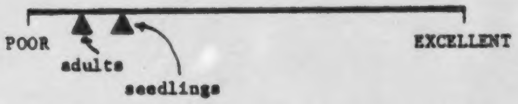
PHYSICAL DESCRIPTION: A middle aged pine (matures about 50-70 years), usually growing around 70 to 80 feet tall. The needles are grouped in twos and slightly twisted. Both the needles and wood are very resinous. Bark on the younger trees is relatively thin, but thickens as the tree ages. The root system is shallow and spreading (most of it is in the upper 18 or so inches of the soil).

SEEDS: Winged. Seeds are produced and held in cones which are sealed with resin. They are held on the tree rather than shed each year (sometimes for as long as twenty five years.) and accumulate as the tree gets older. High temperatures (around 122 degrees Fahrenheit) are needed to begin melting the resin, allowing the cone to open, and gradually release the seeds. The seeds themselves are also heat tolerant.

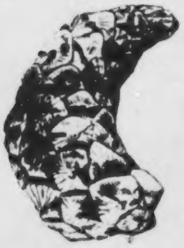
SEEDLINGS: Seedlings do best on bare soil or where the mat of dead needles or leaves is reduced to a thin layer. While they are more tolerant of shade than the adult trees, they cannot stand being totally over shaded.

SPROUTING: Jack pine does not sprout.

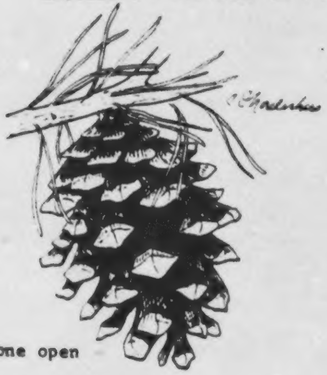
***TOLERANCE OF SHADE:**



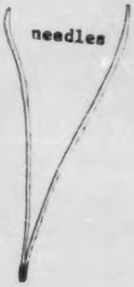
*Poor - Cannot grow or survive in any shade
Excellent - Survives in very shaded conditions



cone closed



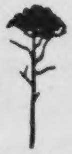
cone open



needles

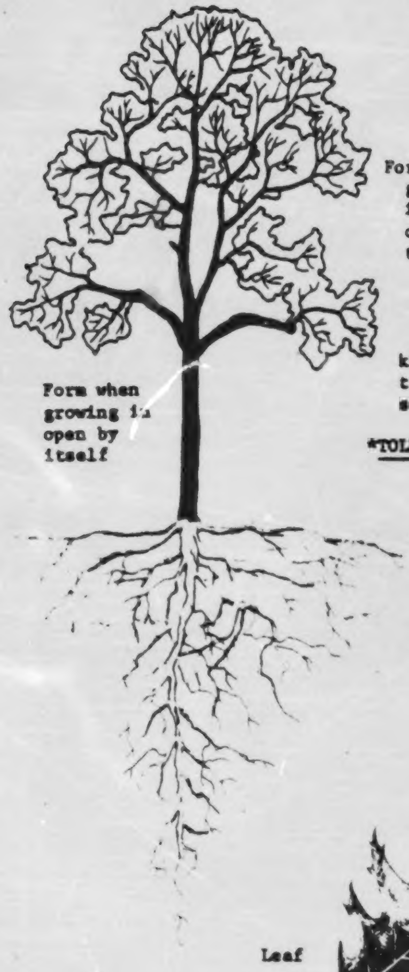
NORTHERN RED OAK

PHYSICAL DESCRIPTION: Medium sized broadleaf tree averaging 70-90 feet high and 2-3 feet in diameter. The bark is smooth and thin in younger trees, thicker and furrowed in older ones. The roots are deep and branching.


Form when
growing
in among
other
trees

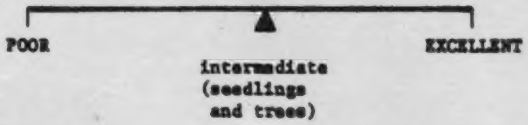
SEEDS: Acorns. Trees begin producing them when about 25 years old but not abundantly until around 50 years old. Seeds mature in the fall, lay dormant on the forest floor over the winter, and germinate in the spring. Germination best in the soil covered by dead leaves and twigs (due to increased moistness).

SEEDLINGS: Moisture critical factor in early survival. If roots manage to penetrate through the dead leaves and twigs on the forest floor, the seedlings are more resistant to dry weather making survival better.

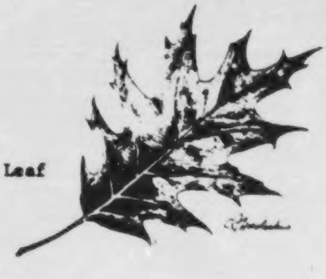

Form when
growing in
open by
itself

SPROUTING: Produces many sprouts when cut down or killed by fire (sprouts develop from stump or roots). trees from sprouts develop as well as those from seeds.

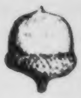
*TOLERANCE OF SHADE:


POOR
EXCELLENT
intermediate
(seedlings
and trees)

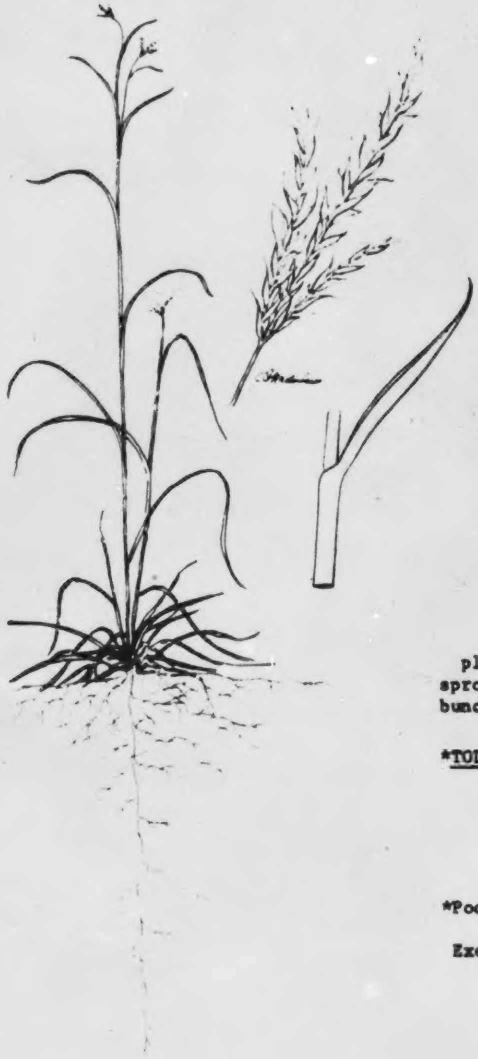
*Poor - Cannot grow or survive in any shade
Excellent - Survives in very shaded conditions


Leaf

Seed



BIG BLUESTEM



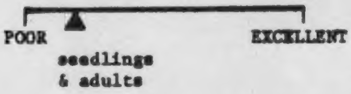
PHYSICAL DESCRIPTION: Big Bluestem — also called Bluejoint, Turkeyfoot, or Beardgrass -- is a perennial grass (one that lives through at least two years as opposed to an annual, one that dies at the end of the growing season.) that grows in bunches up to six feet tall. Leaves are narrow (about 3/8"), stems are solid and may be branched at the top. The above ground part of the plant grows from underground stems (rhizomes). Growth starts in the late spring (around May) and continues through the summer, with flowering and seed producing occuring in late summer. The above ground part of the plant dies back in the fall while the rhizomes become dormant over the winter. The root system is extensive and penetrates deeply (6-7 feet).

SEEDS: Seeds are small and light, and scattered by the wind.

SEEDLINGS: To succeed, seedlings need relatively sunny spots without to much competition and little or no dead mat of vegetation (litter) separating them from the soil.

SPROUTING: Big Bluestem establishes new plants by seed but spreads by extending and sprouting from rhizomes, eventually forming a bunch.

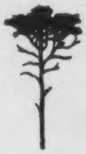
*TOLERANCE OF SHADE:



*Poor - Cannot grow or survive in any shade.
Excellent - Survives in very shaded conditions.

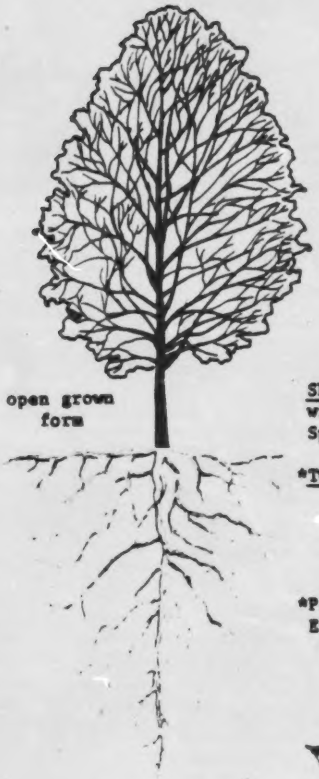
SUGAR MAPLE

__PHYSICAL DESCRIPTION__: Sugar Maple is a fairly long lived (300-400 years) broadleaf tree, averaging 70-110 feet tall, and maturing around 150 years old. In the open, the tree branches close to the ground, but when growing in among other trees, the trunk remains relatively clear of branches. On younger trees, the bark is smooth and very thin. As the tree gets older, the bark furrows and thickens, but usually does not get more than one inch thick. The root system is deep and branching.


form when grown in forest among other trees

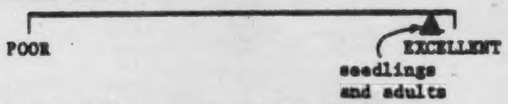
__SEEDS__: Winged and spread by the wind. Seed crops on younger trees are light, but get heavier as the tree gets older. Seeds ripen in the fall, lay on the forest floor over the winter and germinate in the spring.

__SEEDLINGS__: Seedlings have no trouble establishing themselves in shaded conditions. Cool, moist conditions are best for seedling development. Seedlings are not hindered by deep layers of dead leaves and other decaying vegitation on the forest floor.

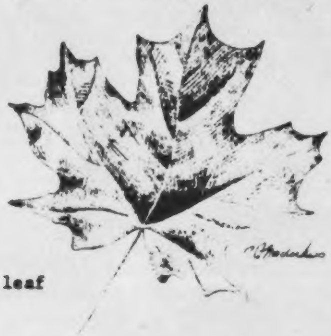

open grown form

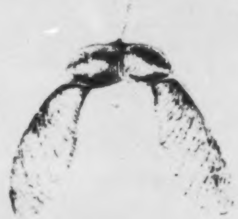
__SPROUTING__: Sprouting from stumps happens, but amount decreases with age, tree size, and, if cut, years since cutting. Sprouting after a fire is less common.

__*TOLERANCE OF SHADE__:

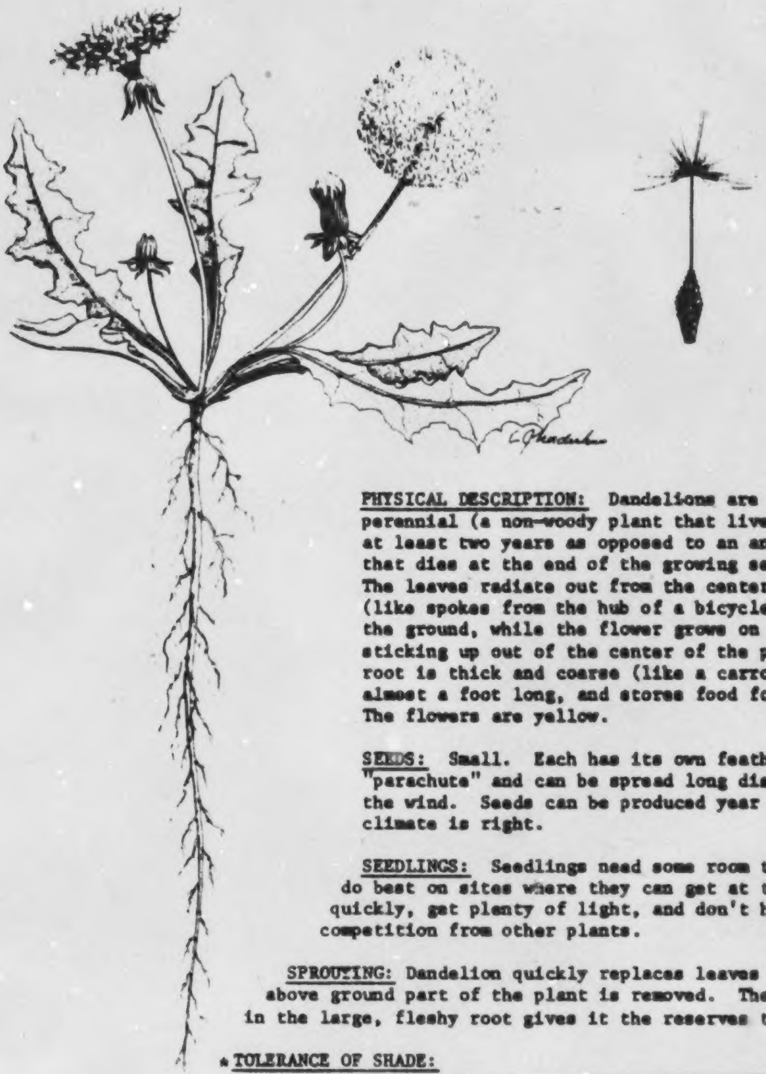


*Poor - Cannot grow or survive in any shade
Excellent - Survives in very shaded conditions.


leaf



DANDELION



PHYSICAL DESCRIPTION: Dandelions are stemless, perennial (a non-woody plant that lives through at least two years as opposed to an annual, one that dies at the end of the growing season.) plants. The leaves radiate out from the center of the plant (like spokes from the hub of a bicycle wheel) on the ground, while the flower grows on a stalk sticking up out of the center of the plant. The root is thick and coarse (like a carrot), may be almost a foot long, and stores food for the plant. The flowers are yellow.

SEEDS: Small. Each has its own feathery "parachute" and can be spread long distances by the wind. Seeds can be produced year round if the climate is right.

SEEDLINGS: Seedlings need some room to grow. They do best on sites where they can get at the soil quickly, get plenty of light, and don't have too much competition from other plants.

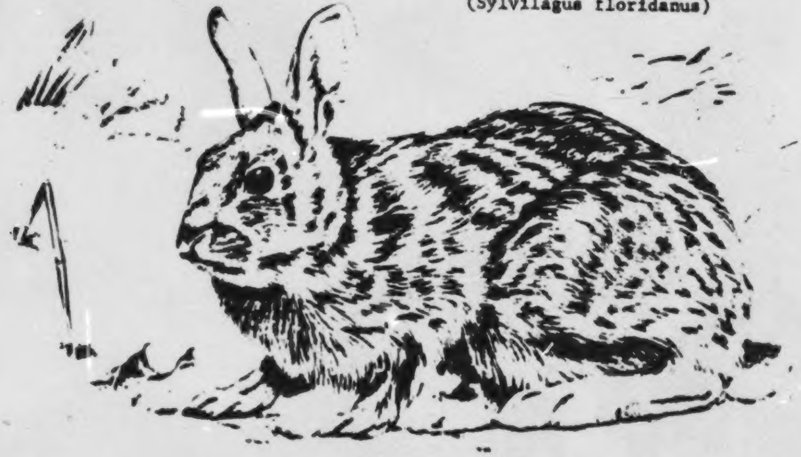
SPROUTING: Dandelion quickly replaces leaves when the above ground part of the plant is removed. The food stored in the large, fleshy root gives it the reserves to sprout repeatedly.

***TOLERANCE OF SHADE:**

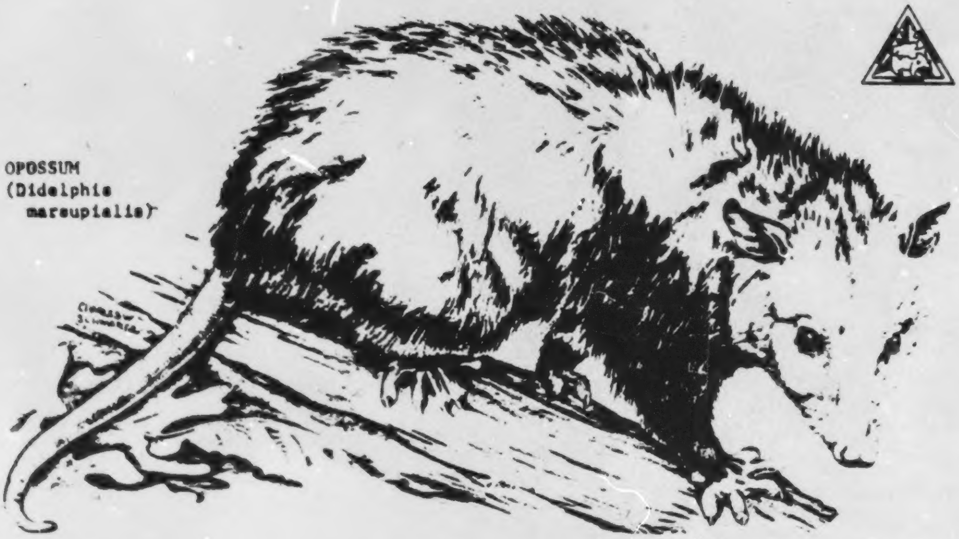
POOR ———————————————— EXCELLENT
seedlings
& adults

*Poor - Cannot grow or survive in any shade.
Excellent - Survives in very shaded conditions.

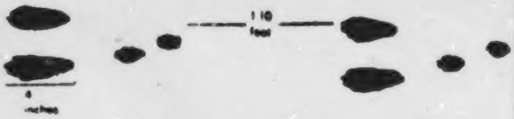
EASTERN COTTONTAIL RABBIT
(Sylvilagus floridanus)



OPOSSUM
(Didelphis
marsupialis)



EVIDENCE:



- DROPPINGS SMALL, ROUND-1/8 TO 1/4 INCH DIA. DULL, DRY TAN OR GLOSSY, MOIST BROWN TO DARK GREEN.
- "FARMS" UNDER BRUSH CLUMPS NEAR NARROW, WELL WORN TRAILS.
- SMALL, 5-6 INCHES DIA. BURROWS FOR NEST CAVITIES IN DENSE GRASS, OTHER COVER. CHECK FOR CHARACTERISTIC RABBIT FUR.
- RABBIT FUR IN OR AROUND UNDERGROUND DENS OF OTHER ANIMALS (E.G. WOODCHUCK BURROWS).
- SMALL TWIGS OR YOUNG TREE TRUNKS WITH BARK EATEN NEAR GROUND LEVEL-TOOTH MARKS EVIDENT.

HABITAT:

OPEN BRUSHY OR FOREST BORDER TYPE COVER. WEEDY FENCE ROWS, HEDGE FENCES, THICKETS, DENSE HIGH GRASS, BRUSH PILES.

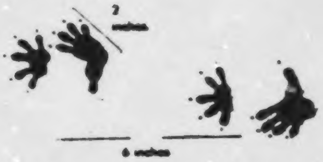
FOODS:

ENTIRELY VEGETARIAN. GRASSES, SEDGES, HERBS, CLOVER, ALFALFA, SOYBEANS, WHEAT, RYE, VARIOUS GARDEN VEGETABLES. IN WINTER, FRUITS, BERRIES, CORN, BUDS, TWIGS, BARK OF SHRUBS, VINES AND TREES.

PREDATORS:

HAWKS, OWLS, CROWS, FOXES, COYOTES, MINKS, WEASELS, DOGS, CATS, SNAKES, MAN.

EVIDENCE:



- DROPPINGS VARIABLE WITH FOOD EATEN-NOT DISTINCTIVE.
- HOME SITES GENERALLY ANY PLACE THAT IS DRY, SHELTERED, SAFE.
- DENS OR NEST OF OTHER ANIMALS, CAVITIES IN ROCKS, BRUSH PILES, TRASH HEAPS, HOLLOW TREES AND LOGS, BARNS, GARAGES, ETC.

HABITAT:

PREFER WOODED AREAS NEAR STREAMS; FARMING AREAS WITH TIMBER NEAR SOURCES OF WATER SUCH AS PONDS AND LAKES. EXTREMELY ADAPTABLE TO VARYING HABITATS.

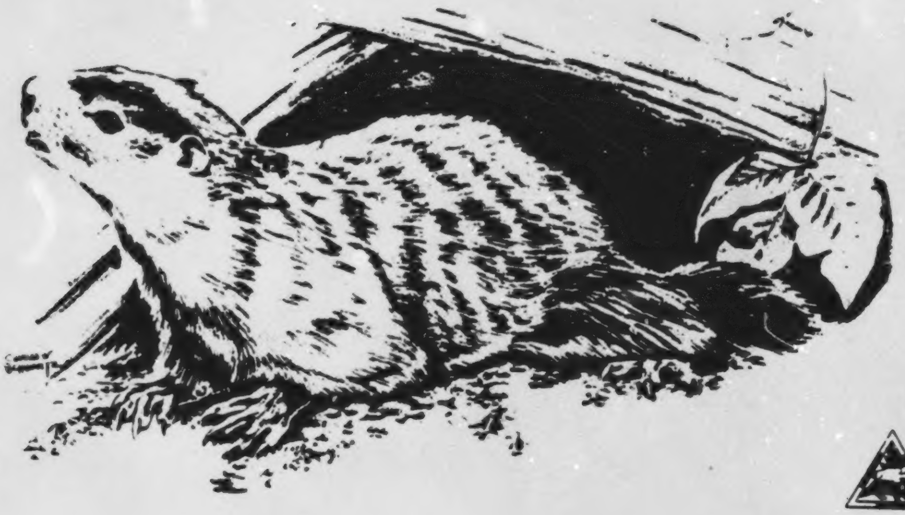
FOODS:

PLANT-FRUITS, DURING FALL AND EARLY WINTER, INCLUDING POKEBERRIES, MULBERRIES, HACKBERRIES, GREEN BRIERS, GROUND CHERRIES, GRAPES, BLACKBERRIES, APPLES, PAWPAWS, HAWS, PERSIMMONS. ALSO CORN.

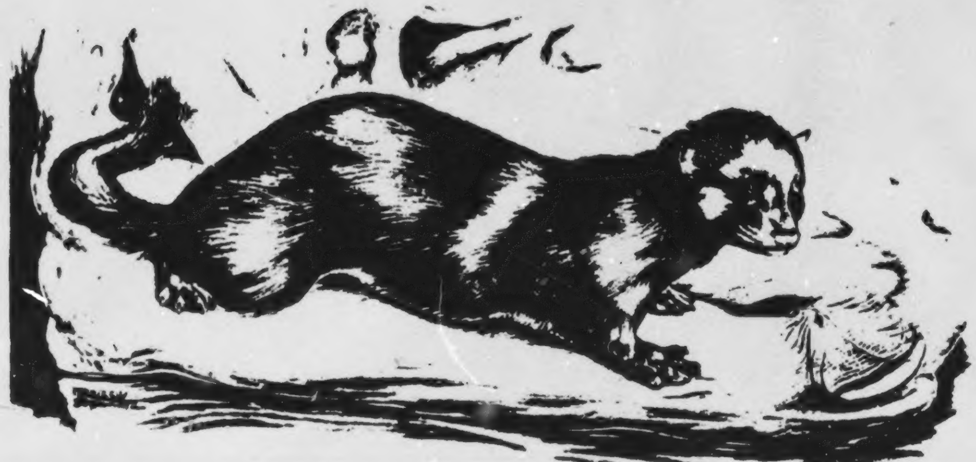
ANIMAL-MOSTLY CARRION (DEAD ANIMALS, BOTH WILD & DOMESTIC). ALSO INSECTS, SNAKES, FROGS, TOADS, BIRDS & EGGS, SNAILS, CRAYFISH.

PREDATORS:

MAN, DOGS, FOXES, COYOTES, BOBCATS, OWLS.

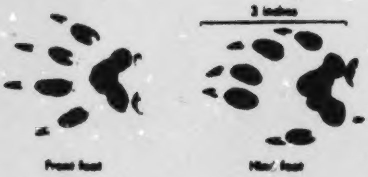


WOODCHUCK
(Marmota monax)



Mink (Mustela vison)

EVIDENCE:



- CONSPICUOUS PILE OF EXCAVATED DIRT AT MAIN ENTRANCE TO BURROW-UP TO 4½ FEET IN DIA.
- BURROW MAIN ENTRANCE HOLE APPROX. 1 FOOT IN DIA.
- BURROW SIDE ENTRANCES SMALL, WELL CONCEALED WITH DIRT PILE ABSENT.
- HAIR, TRACKS AT ENTRANCE CLUES TO KIND OF ANIMAL OCCUPANT.

HABITAT:

TIMBER BORDERED BY OPEN LAND. ALONG FENCE ROWS AND HEAVILY VEGETATED GULLIES OR STREAM BANKS. SUMMER DENS OFTEN IN OPEN CROP FIELDS OR GRASSLANDS.

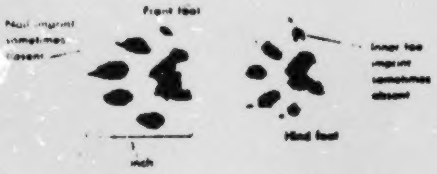
FOODS:

PRIMARILY VEGETARIAN-LESS THAN 1% OF DIET IS ANIMAL FLESH. LEAVES, FLOWERS, STEMS OF GRASSES, CLOVER, ALFALFA AND MANY WILD HERBS. GARDEN CROPS LIKE PEAS, BEANS, CORN. ALSO APPLES, PAWPAWS. OCCAIONALLY GRASSHOPPERS, SNAILS, JUNE BUGS, YOUNG BIRDS, BIRD EGGS.

PREDATORS:

FOXES, COYOTES, DOGS, BOBCATS, MINKS, WEASELS, HAWKS, OWLS, LARGE SNAKES, MAN.

EVIDENCE:


Nail imprint sometimes absent
Front foot
Inner toe imprint sometimes absent
Hind foot
1 inch

- DROPPINGS LONG AND SLENDER-SIMILAR TO WEASEL BUT LARGER. FOLDED OR IRREGULARLY SEGMENTED WHEN CONSISTING OF FUR. COLOR EXTREMES FROM WHITE TO BLACK DEPENDING ON DIET.
- DENS UNDER TREE ROOTS, STREAM BANK CAVITIES, UNDER LOGS AND STUMPS, IN HOLLOW TREES, MUSKRAT LODGES.
- NEST CHAMBER APPROX. 1 FT. IN DIA. LINED WITH GRASS, LEAVES, FUR OR FEATHERS.

HABITAT:

ONE BASIC HABITAT REQUIREMENT IS PERMANENT WATER. TIMBER ADJACENT TO WATER IS PREFERRED BUT NOT ESSENTIAL. DWELL ALONG STREAM AND RIVER BANKS OR SHORELINES OF PONDS, LAKES, MARSHES

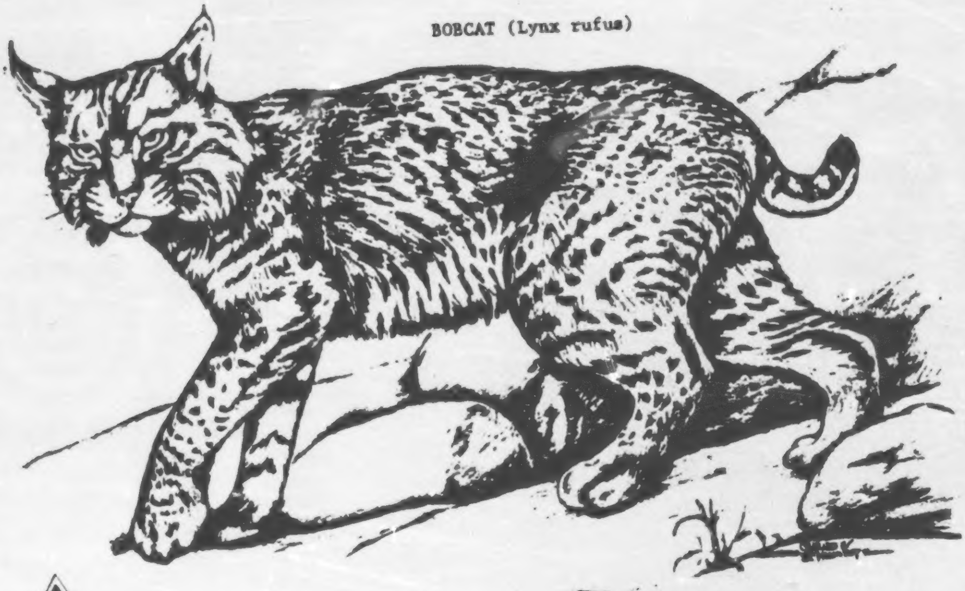
FOOD:

DIET MIXTURE BETWEEN TERRESTRIAL AND AQUATIC FORMS. INCLUDES: RATS, MICE, RABBITS, BIRDS, SQUIRRELS, INSECTS, SPIDERS, SNAILS, DOMESTIC CATS, SHREWS, MOLES, BATS, TURTLES AND THEIR EGGS, SNAKES, BIRD EGGS, FROGS, FISH, CRAYFISH, MUSKRATS.

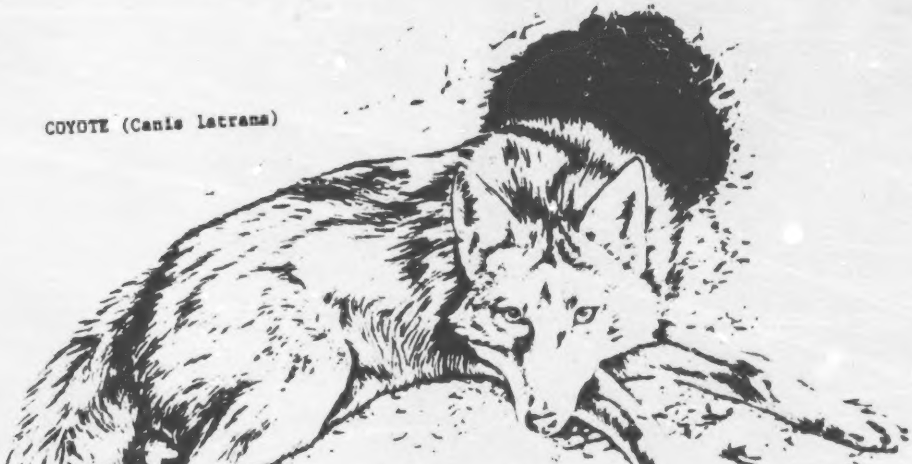
PREDATORS:

OWLS, FOXES, COYOTES, BOBCATS, DOGS, MAN.

BOBCAT (Lynx rufus)



COYOTE (Canis latrans)



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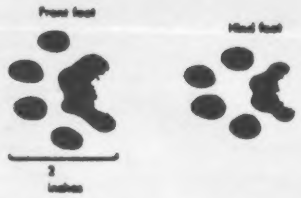


- LARGE (2") FOUR-TOED TRACKS WITHOUT CLAW MARKS.
- DROPPINGS SEGMENTED BUT EASILY CONFUSED WITH COYOTE AND DOG.
- DROPPINGS USUALLY COVERED-SCRATCH MARKS MAY SHOW.
- SCRATCH MARKS ON TREES FROM CLAW SHARPENING.
- REST SHELTERS IN THICKETS, STANDING OR FALLEN HOLLOW TREES, OR ROCKY CLIFF RECESSES.
- WHELPING NESTS MADE OF DRIED LEAVES AND MOSS.

HABITAT:

HEAVY FOREST COVER, PREFERABLY SECOND GROWTH TIMBER WITH UNDERBRUSH, CLIFFS AND CLEARINGS. ALSO TIMBERED SWAMPS.

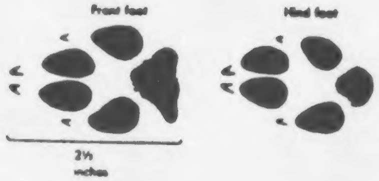
FOODS:

RABBITS, RATS, MICE, SHREWS, SQUIRRELS DEER (MOSTLY CARRION), OPPOSSUMS, DOMESTIC CATS, WILD TURKEYS, QUAIL, OCCASIONAL GRASSES.

PREDATORS:

MAN AND DOGS ARE CHIEF PREDATORS. ALSO FOXES, COYOTES, GREAT-HORNED OWLS ON YOUNG.

EVIDENCE:



- DOG-LIKE DROPPINGS WITH HAIR.
- PARTIALLY EATEN REMAINS OF ANIMALS, LEG BONES BROKEN.
- DENS IN UNUSED FIELDS; BANKS; ROCK CAVITIES; UNDER HOLLOW TREES, LOGS, DESERTED BUILDINGS, BRUSH PILES. "REMODELED" DENS OF WOODCHUCKS. DENS WITH ONE OR MORE OPENINGS, 1-1½ FEET IN DIAMETER.

HABITAT:

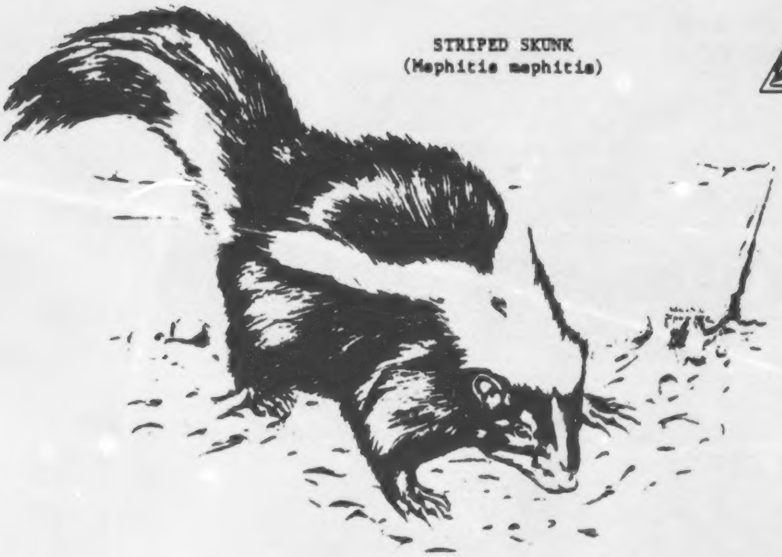
BRUSHY AREAS; ALONG THE EDGE OF TIMBER; OPEN FARMLANDS.

FOODS:

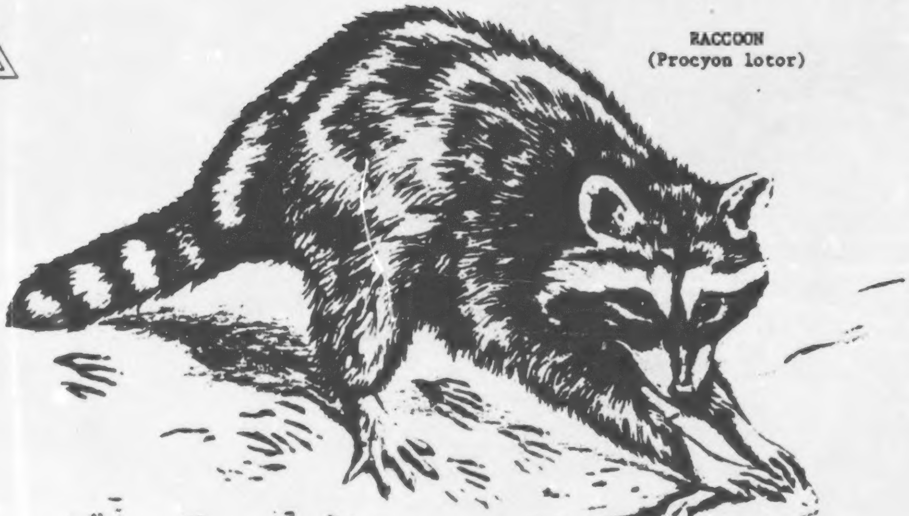
OLD, SICK, WEAK ANIMALS USUAL PREY. MAINLY RABBITS, RATS, MICE. ALSO BIRDS, INSECTS, OTHER WILD MAMMALS, PLANTS, CARRION (DEAD ANIMALS), POULTRY, LIVESTOCK.

PREDATORS:

DOGS, GREAT-HORNED OWLS, BOBCATS (ON YOUNG). MAN IS THE CHIEF PREDATOR.

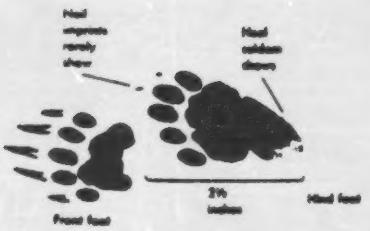


STRIPED SKUNK
(Mephitis mephitis)



RACCOON
(Procyon lotor)

EVIDENCE:



- Droppings may have musty odor, not strong musk smell.
- Dens in ground, stumps, refuse dumps, caves, rock piles, rock crevices, under buildings. Abandoned dens of woodchucks, foxes, etc. often used.
- Faint skunk odor around den.
- Distinctive black and/or white hairs around den openings.
- Ground pitted from digging for insects, forest leaf litter disturbed.

HABITAT:

Varies with land use but prefer forest borders, brushy field corners, fence rows, or open grassy fields with wooded ravines and rock outcrops near permanent water.

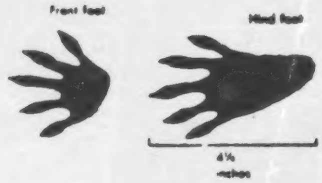
FOODS:

Insects and larvae preferred food including bees and wasps. Also rats, mice, moles, shrews, ground squirrels, chipmunks, young rabbits, carrion, fruits. Occasionally birds and their eggs, lizards, salamanders, frogs, earthworms, crayfish, clams, minnows, turtle eggs, grasses, leaves, buds, roots, nuts, grains, fungi.

PREDATORS:

Great-horned owls, coyotes, foxes, badgers, bobcats-on young when other food scarce. Dogs, man.

EVIDENCE:



- Droppings of granular appearance, even dia., lack of taper.
- Shells of crayfish, fresh water clams
- Dens in hollow trees and logs, caves, rock crevices, abandoned woodchuck burrows, cavities under tree roots, cornshocks, haystacks, squirrel nests, barns, deserted buildings, muskrat houses.

HABITAT:

Hardwood timber areas-either dense forest or timber border of rivers, streams, lakes or ponds.

FOODS:

Plant-persimmons, grapes, plums, choke cherries, blackberries, grasses, sedges, corn, acorns, pecans, other nuts, Osage Orange, greenbriars, mulberries.

Animal-crayfish, clams, fish, insects, spiders, frogs, snakes, turtles and their eggs, snails, earthworms, eggs and young of birds, mice, squirrels, rabbits, muskrats, occasionally poultry.

PREDATORS:

Man, dogs. Great-Horned Owls, bobcats, coyotes (on young).

EVALUATION SURVEY

Forest Service
Respondents

PART I, Problem Areas and Use Potential

1. Clarity of Directions

1.1 How would you describe the directions for the instructor?

$\bar{x} = 4.05$
sd = .780

	1	2	11	5
1	2	3	4	5
very confusing and difficult to follow				very clear and easy to understand

1.2 Based on your experience, how do you think participants in a "process approach" or other workshop would find the directions?

$\bar{x} = 3.89$
sd = .994

	2	4	7	6
1	2	3	4	5
very confusing and difficult to follow				very clear and easy to understand

Comments: ______________________________

2. Estimated Time Frame for Tasks

In general, do you think the stated completion time for the task is:

$\bar{x} = 3.33$
sd = .767

	2	9	6	1
1	3	3	4	5
too long		just about right		too short

Comments: ______________________________

3. Lesson plan/objectives relationship (Objectives stated on the last page of the lesson plan)

Do you think the learning experiences provided by the lesson plan will result in the stated objectives being met:

$\bar{x} = 3.83$
sd = .924

1	0	3	11	3
1	2	3	4	5
poorly				excellently

Comments: ______________________________

4. Flow of Information

4.1 From the instructor's point of view, did you find the flow of ideas, concepts, and information:

$\bar{x} = 3.89$
sd = .900

	2	2	10	4
1	2	3	4	5
very confusing hard to follow				very clear, easy to follow

4.2 How clear do you think participants in a "process approach" or other workshop would find the flow of information?

$\bar{x} = 3.53$
sd = .905

	2	8	6	3
1	2	3	4	5
very confusing, hard to follow				very clear easy to follow

Comments: ______________________________

5. **Ease of Use**

Assuming that the appropriate site and materials are available, do you think this lesson plan would be:

$\bar{x} = 3.79$
sd = 1.23

1	2	4	5	7
1	2	3	4	5
very difficult to facilitate				very easy to facilitate

Comments: ______________________________

6. **Materials**

6.1 Given your present situation, would the materials required for the lesson plan:

$\bar{x} = 3.89$
sd = .875

	1	5	8	5
1	2	3	4	5
be too difficult to acquire*				be very easy to acquire

6.2 In your opinion, are the materials in (or required by) the lesson plan adequate for (check one):

6.21 the instructor? 19 yes 0 no 0 no opinion

6.22 the participant? 18 yes 1 no 0 no opinion

6.3 What other materials or information (if any) would you like to see:

6.31 for the instructor? no comment = 15
comment = 3

6.32 for the participant? no comment = 15
comment = 3

Comments: ______________________________

*either by making your own or purchase.

7. Use Potential

7.1 Given your present situation and the materials needed, could you (answer as many as apply):

7.1 a. use the entire lesson plan as designed. 13 yes 5 no

7.1 b. use individual tasks or series of tasks as designed. 18 yes 1 no

7.1 c. modify the tasks and/or discussion to suit your needs. 18 yes 0 no

7.1 d. use it as an idea source. 16 yes 0 no

7.1 e. not use it at all. 1 yes 5 no

7.2 Would you use this lesson plan (or parts of it) in the foreseeable future? 11 yes 1 no 7 don't know

If you answered "no" or "don't know", please indicate the reason(s) below: (check as many as apply)

7.2 a. I don't know enough about fire in the environment. 2

7.2 b. I'm not interested in the topic. 0

7.2 c. I don't think the participants would find the topic of value to them. 1

7.2 d. I don't think the participants would find the tasks interesting. 0

7.2 e. I think other topics are more important. 0

7.2 f. It doesn't fit into the process approach workshops or other program I'm involved in 0

7.2 g. Other: 8 comments — 5 - workload reduces opportunity not in EE as much.
1 - prefer present investigations.
1 - amount of content inhibiting.
1 - hesitant to use "alone", use in relation to other investigations.

Comments: ______________________________

8. Based on your experience as a workshop participant and/or facilitator, how would you compare, on an overall basis, this investigation lesson plan with the four presently used in the process approach workshops (Soil, Water, Forest, and Habitat)?

$\bar{x} = 3.11$
sd = .658

1	4	7	7	
1	2	3	4	5
much less effective a learning experience		about as effective a learning experience		much more effective a learning experience

PART II: Adaptability

1. Adaptability for shortening.

1.1 Do you feel this lesson plan can be adapted for shorter time periods by omitting various tasks? 16 yes 5 no

1.2 Which tasks do you think would be the best to OMIT to save time. Indicate your first choice with a 1 (first omitted), your second with a 2 (second omitted), etc. If you think the task should not be omitted, leave its space blank.

Task A 42*	Task E 9	Task I 25
Task B 22	Task F 6	Task J 67
Task C 18	Task G 14	Task K 68
Task D 45	Task H 14	

*Task omission scores, not number of respondents

2. Adaptability for Task Use out of Context

2.1 Do you feel there are tasks in this lesson plan that could stand alone as a learning experience?

15 yes 1 no 0 don't know

2.2 If so, which ones? (check as many as apply)

Task A 8
Task B 8
Task C 8
Task D 3

Task E 7
Task F 9
Task G 7
Task H 3

Task I 7
Task J 5
Task K 5

PART III: Suggestions for Improvement

In the Space below and/or on the lesson plan itself, please make any comments or suggestions which you think would improve the effectiveness of the lesson plan; or any other comments you may have on overall content, value, style, etc.

See Text.

*****THANKS FOR YOUR HELP!*****

EVALUATION SURVEY

PART I, Problem Areas and Use Potential

1. Clarity of Directions

*How would you describe the directions for the instructor?

$\bar{x} = 4.2$
sd = .837

		1	2	2
1	2	3	4	5
very confusing and difficult to follow				very clear and easy to understand

*Based on your experience as a teacher, how do you think your students would describe the directions on the task cards?

$\bar{x} = 3.6$
sd = .894

		3	1	1
1	2	3	4	5
very confusing and difficult to follow				very clear and easy to understand

Comments: ____________________

2. Estimated Time Frame for Tasks

*In general, do you think the stated completion time for the tasks is:

$\bar{x} = 3.5$
sd = .577

		2	2	
1	2	3	4	5
too long		just about right		too short

Comments: ____________________

3. Lesson Plan/Objectives Relationship
(Objectives stated on the last page of the lesson plan)

*Do you think the learning experiences provided by the lesson plan will result in the stated objectives being met:

$\bar{x} = 4.4$
sd = .548

			3	2
1	2	3	4	5
poorly				excellently

Comments: ____________________

4. Flow of Information

*From a teacher's point of view, did you find the flow of ideas, concepts, and information:

$\bar{x} = 4.00$
sd = 1.00

		2	1	2
1	2	3	4	5
very confusing, hard to follow				very clear, easy to follow

*How do you think your students would find the flow of information?

$\bar{x} = 3.8$
sd = .837

		2	2	1
1	2	3	4	5
very confusing, hard to follow				very clear, easy to follow

Comments: ____________________

5. Ease of Use

*Assuming that you had an appropriate site, the required materials, and the time available, do you think this lesson plan would be?

$\bar{x} = 3.8$
sd = .447

		1	4	
1	2	3	4	5
very difficult for you to use				very easy for you to use

Comments: ____________________

6. Materials

*Given your present situation, would the materials required for the lesson plan:

$\bar{x} = 3.8$
sd = 1.095

		3		2
1	2	3	4	5
be too difficult to acquire*				be very easy to acquire

*either by making your own or purchase.

*In your opinion, are the materials in (or required by) the lesson plan adequate for (check one):

the instructor?	4 yes	1 no	0 no opinion
the student?	4 yes	1 no	0 no opinion

*What other materials or information (if any) would you like to see:

for the instructor? no comment = 5
comment = 0

for the student? no comment = 5
comment = 0

Comments: ____________________

7. Use Potential

*Given your present situation and the materials needed, could you (answer as many as apply):

a. use the entire lesson plan as designed? 5 yes 0 no

b. use individual tasks or series of tasks as designed? 4 yes 0 no

c. modify the tasks and/or discussion to suit your needs? 4 yes 0 no

d. use it as an idea source? 4 yes 0 no

e. not use it at all? 1 yes 0 no

*Would you use this lesson plan (or parts of it) in the foreseeable future? 3 yes 0 no 0 don't know

*If you answered "no" or "don't know", please indicate the reason(s) below: (check as many as apply)

I don't know enough about fire in the environment. 0

I'm not interested in the topic. 0

I think other topics are more important. 0

I don't think my students would find the tasks interesting. 0

I don't think my students would find the topic interesting. 0

I don't think my students would find it of value to them. 0

It doesn't fit into the time frame I have to work in. 0

I can't get my kids outside. 0

It doesn't fit in with the present curriculum. 0

The format doesn't fit the way I teach. 0

Other: no comments

Comments: ______________________________

PART II: Adaptability

1. Adaptability for shortening.

Do you feel this lesson plan can be adapted for shorter time periods (i.e. shorter than need to do the entire lesson plan) by omitting various tasks? 3 yes 0 no

*Which tasks do you think would be the best to OMIT to save time. Indicate your first choice with a 1 (first omitted), your second with a 2 (second omitted), etc. If you think the task should not be omitted, leave its space blank.

Task A	17	Task E	0	Task I	0
Task B	0	Task F	9	Task J	0
Task C	0	Task G	0	Task K	0
Task D	0	Task H	0	Task L	n/a

2. Adaptability for Task Use out of Context

*Do you feel there are tasks in this lesson plan that could stand alone as a learning experience? 2 yes 1 no 0 don't know

*If so, which ones? (Check as many as apply)

Task A	___	Task E	___	Task I	___
Task B	___	Task F	___	Task J	___
Task C	___	Task G	___	Task K	___
Task D	___	Task H	___	Task L	n/a

PART III: Suggestions for Improvement

In the space below and/or on the lesson plan itself, please make any comments or suggestions which you think would improve the effectiveness of the lesson plan; or any other comments you may have on overall content, value, style, etc.

*****THANKS FOR YOUR HELP!*****

(C)

A LESSON PLAN FOR INVESTIGATING

LAND USE, INTEREST GROUPS, AND FIRE

Instructor: Set the stage for the investigation by telling the participants what they will be doing. For example: "Today, during the next 3½ - 4 hours we are going to take a look at some different ways land is used; explore what interest groups are and how they might affect land use decisions; and investigate what goes into making a land use decision and how fire might affect it.

1. Let's start off by using these aerial photos and, taking about 10 minutes, do Task A.

TASK A

Work in small groups.

Land can be used in many different ways. List as many different uses as you can find on the aerial photo:

1.

2.

3.

4.

DISCUSSION

1. What kinds of uses did you find? *Instructor: List on one side of a large sheet of paper or blackboard.*

2. Suppose we were considering changing the use of the land around here for, say ____________ (pick one fo the uses mentioned in response to the previous question). What groups or types of people would be interested in or affected by the change? *Instructor: List on the other side of the paper or board.*

3. Using the data we have generated, take about 15 minutes and do Task B.

TASK B

Work alone or in pairs

Analyze the relationships between the new land use proposed in the discussion and three or four of the interest groups mentioned. Indicate which groups might benefit by the change by drawing a line from the land use to the group. Then, using a pencil or a pen of a different color, draw lines from the land use to interest groups that would be hurt by or dislike the change.

		Interest Groups	How the change would benefit/hurt the group
	1.		
New Land Use:	2.		
______________	3.		
	4.		

DISCUSSION

1. What groups did you list as benefiting? *Instructor: As they are mentioned draw lines connecting the land use and the interest groups.*

2. What groups did you list as being hurt by or disliking the change? *Instructor: Again, draw in lines. At this point, there may be interest groups that are listed as both benefiting and being hurt by the change. If this occurs, inquire as to why.*

3. How might these relationships change if we were considering another land use, say ___________? (pick another one from the list).

4. What affect might these relationships have on land use decision making?

Introduction to the Simulation

1. Very often these different relationships lead to conflicts and make deciding how to use land a difficult matter. What are some ways people might try to resolve these conflicts?

2. *Instructor: Introduce the Simulation itself. For example: "Over the next 1½ - 2 hours we are going to use a simulation, A Burning Issue,* to investigate some things that can complicate making decisions that influence or determine land use; what goes into those decisions; and maybe gain a little insight into how such decisions are made. Let's start by breaking up into seven groups and by reading the Introduction (part 1) and the Sequence of Events (part 2)." Note: Try to keep, as far as possible, the same number of people in each group. Also, be prepared to assign each group an interest group role (or allow each group to chose one). Provide signs for each group so everyone knows who everyone else is. Finally, be sure to have enough Goal Notification, Influence Allocation (parts 5), and message forms (including carbon paper), along with a stopwatch, or watch with a second hand. Once the groups have finished reading the Introduction and the Sequence of Events, answer questions and review the procedure of the game to make sure everyone understands it. After this, tell the groups to go on to Task C. As they begin, pass out Goal Notification and Influence Allocation Forms. Give each group a copy of their goals only. An option here is, instead of giving them goals, have each group generate at least three or four of their own. If this is done, be sure to include it as a step in Task C or as a task by itself.*

TASK C

Work Alone.

1. Read the Current State of Affairs (part 3)

2. Note your interest group goals on the Goal Notification form. *Instructor: If you plan on having the groups vote at the end of the simulation, have them rank their goals (most to least important) and return the form to you.*

3. Read the six Policy Alternatives (part 4).

4. Decide which of the six Policy Alternatives (there may be more than one) would establish your group's desired policy for Engel County consistant with your group's goals; and develop a strategy for using the influence of your group and others to establish those desired policies.

5. Notify the instructor when you are ready to continue.

---

* Format used with the kind permission of Dr. Paul Mehne.

Instructor: Announce the beginning of round 1 when all groups have notified you they are ready to continue. However, do not wait too long for any one group if the others are ready to go. After announcing the beginning of round 1, do the following:

1. About 10 minutes into the first round, announce the availability of the Population and Housing Projections and a section of the report on the Ecology of the Brushland.
2. Make special announcements as you deem necessary throughout the round.
3. Five minutes before the round ends, announce that the Influence Allocation Forms will be due at the end of the round.
4. When the messenger (if you are using one) brings you requests for conferences, assign a time and location for each conference, and have the messenger return the forms to each of the appropriate chairmen.
5. At the end of round 1, announce that in order to be adopted at the end of the game a policy must be supported by a net influence point total of 325. At the end of the round, report the results of the Influence Allocation Forms. This can be done two ways: (1) Disclose only the total points earned by each policy (positive and negative); or (2) Disclose the point total for each policy and how each group voted. If you use the latter option, you may want to use an enlarged version of the Influence Allocation form to record and report the results.
6. At the end of the third round, post the final results (again, you can use an enlarged version of the Influence Allocation form to record and report the results.). If you didn't report how each group voted at the end of the previous rounds, do so now. An option here is to have the group as a whole vote to decide which interest group came closest to achieving its goals as ranked by it in the beginning of the game (if you plan to do this, make sure to use the Goal Notification Forms at the beginning of the simulation.). To do this, have each group share their goals with the other groups, then have the rest of the group vote on that group. After the voting is over, go into the post simulation discussion.

DISCUSSION

1. Instructor: The post simulation discussion is very important because it allows the participants to explore what they and other groups did during the simulation and why, how they felt, etc. It also can explore the relationships between what happened in the game and possible real life situations, how they might be similar and (possibly more important) what has been left out of the simulation that would be present in the real world. Of course, this discussion can end up following many different routes. The set of questions below are a couple of suggested areas that could be covered. Use them if you like or take a different direction if you prefer.
2. What did you find happening during the game?

3. What kind of strategy worked best for your group?

4. What influence did decisions made by other groups have on yours?

5. What similarities or differences do you think exist between the way decisions were made in the game and how they might be made in real life situations? Should decisions be made in real life like they were in the simulation?

6. How did you feel during the game?

7. What happened during the game to change you feelings? Why?

8. How would you compare your feelings with people in real life?

9. What might have happened if more interest groups and different issues?

10. What other changes could be made to make this simulation as realistic as possible?

11. One of the assumptions we made in the simulation we just finished is that each interest group has an equal amount of influence to use. This isn't always the case (Note: is this was mentioned previously in the post simulation discussion, refer to it.). Keeping this in mind, take about 5-10 minutes and do Task D.

TASK D

Work alone.

Interest groups are a part of any community's land use planning process. Some are more influential than others. List some interest groups that you feel are the more powerful land use influences in your community:

1.

2.

3.

Which of your community's interest groups are you a member of?

DISCUSSION

1. What were some of the groups you listed?

2. What is there about these groups that helps give them more power?

3. How could other interest groups in your community increase their power?

4. Suppose we were thinking about, say __________ (pick another current issue like abortion legislation) instead of land use. What affect would this have on our analysis of interest group power?

5. As a result of our investigations today, what can we say about land use decision making and interest groups?

MATERIALS

Felt tip pens
Large sheets of paper (or blackboard)
Easel stand (if using paper)
*Aerial Photos (optional)
Clipboards
Stopwatch (or watch with a second hand)
Simulation forms (message forms, scoresheets, Policy Alternatives, ect.)
Magnifying glasses (or hand lens - if using aerial photos)
Task cards

OBJECTIVES

After completing this lesson plan, participants should be able to:

1. Given an aerial photograph (roughly 1:24,000 scale), identify at least three types of land use.

2. Define, in their own words, the term interest group.

3. Given a situation where an actual or potential change in land use exists: (a) identify at least three interest groups that would be affected by the change; (b) analyze the relationships between the interest groups and the land use in terms of advantages and disadvantages the land use change offers the interest groups; (c) describe in their own words the impact interest groups as a whole have on land use decision making.

4. Identify three interest groups in their own community.

5. Describe two or more factors that make one interest group more influential that another.

6. Describe the affect periodic natural fires can have on land use in an urban or suburban situation.

*Aerial photos at roughly 1:24,000 scale can be ordered from the National Cartographic Information Center, 507 National Center, Reston, Virginia. 22092. At this writing, photos are available for most areas and are priced at $3.00 per photo (photos are 9 inches square). If possible, send topographic map with desired area outlined on it (topographic maps are also available in scales of 1:24,000). If topographic maps are unavailable to be use for ordering, longitude and latitude coordinates can be used, or in the worst case, a local road map. Contact the National Cartographic Information Center for further information.

A BURNING ISSUE

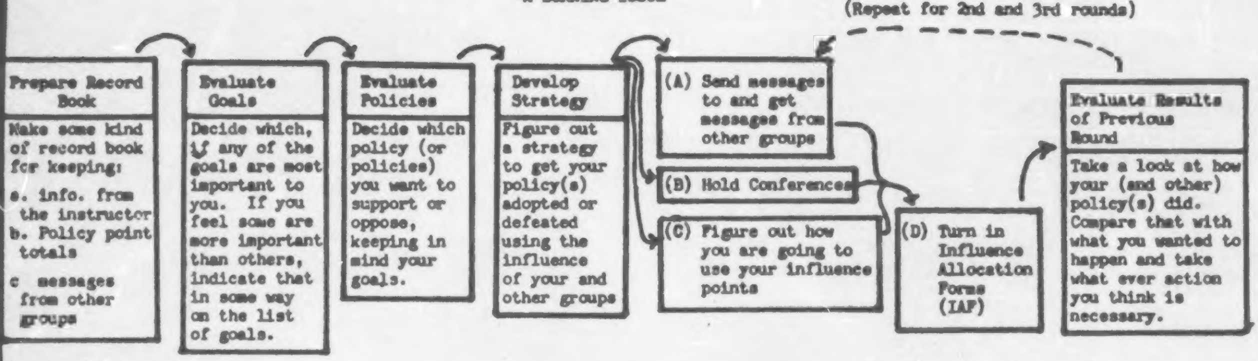
Introduction

In "A Burning Issue" you are a member in one of seven interest groups that use their influence to help determine policy alternatives to a land use related problem. Each interest group has an equal amount of influence to utilize. The interest groups are:

Homeowners (living inside a brushfire hazard area)
Homeowners (living outside a brushfire hazard area)
Home and Commercial Developers
The Board of Supervisors
The Regional Planning Commission
The Insurance Companies
The Fire Department

At any time you can: (1) Talk with any members within your group; (2) Communicate with members of any other group by written messages; (3) Conduct conferences with members of other groups. "A Burning Issue" is divided into three 20 minute rounds, representing the months of April, May, and June. During each round, your group will have 125 influence points to use to indicate your decisions. Reports made at the end of each round by the instructor will indicate which policies are being favored and which are not by each interest group.

SEQUENCE OF EVENTS FOR "A BURNING ISSUE"


(Repeat for 2nd and 3rd rounds)
Prepare Record Book
Make some kind of record book for keeping:
a. info. from the instructor
b. Policy point totals
c messages from other groups
Evaluate Goals
Decide which, if any of the goals are most important to you. If you feel some are more important than others, indicate that in some way on the list of goals.
Evaluate Policies
Decide which policy (or policies) you want to support or oppose, keeping in mind your goals.
Develop Strategy
Figure out a strategy to get your policy(s) adopted or defeated using the influence of your and other groups
(A) Send messages to and get messages from other groups
(B) Hold Conferences
(C) Figure out how you are going to use your influence points
(D) Turn in Influence Allocation Forms (IAF)
Evaluate Results of Previous Round
Take a look at how your (and other) policy(s) did. Compare that with what you wanted to happen and take what ever action you think is necessary.

(A) Each message to each group must be on a separate message form i.e. no one message form may be sent to more than one interest group). Each message form has one original and two carbons. The sending group keeps the original and the receiving group gets the first carbon. The instructor gets the third carbon. NOTE: By writing "RESTRICTED" in the upper left hand corner of the message form, the sending group restricts exposure of the message to the receiving group only. However, that does not insure the message against exposure to other groups.

(B) Conferences may be arranged between two groups if they feel that it will help. After agreement on time, place, etc., has been reached through written message, each group asks the instructor through written message for permission, and a conference location. If one is open, the instructor will assign a time and place.

(C) For each round, each group has 125 influence points to use. They can be used to support a policy (indicated by + influence points) or oppose one (- influence points). Remember: If one group gives a policy +40 points, and another gives it -40 points, the policies net score is 0, and it would not be adopted.

(D) Before each round ends, each interest group must turn in an Influence Allocation Form, indicating which policies they are giving what kind of points to (how many, what kind; + or -). FAILURE TO DO SO WILL MEAN THE LOSS OF ALL INFLUENCE POINTS FOR THAT ROUND. The instructor will announce five minutes before the end of each round that the IAFs are due. The instructor will also inform each interest group of the results of each round.

THE CURRENT STATE OF AFFAIRS

For

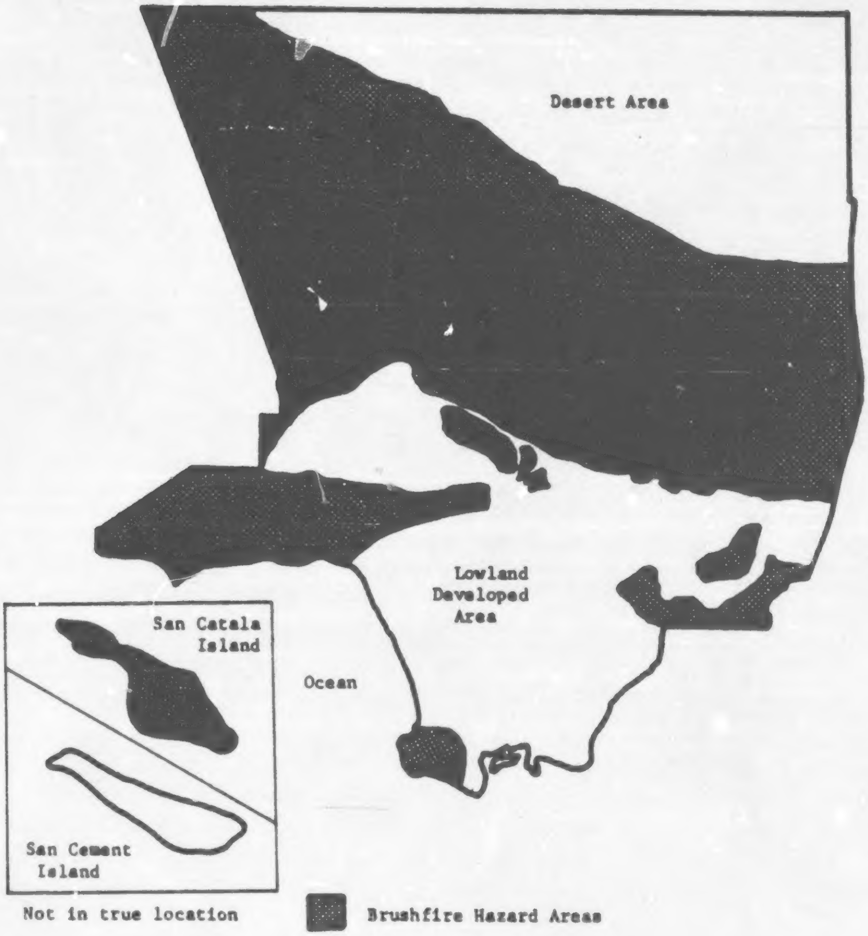
"A Burning Issue"

Assume the following environmental conditions:

Historically, fire has always been a problem in the brush covered hills of Engel county (see map). A combination of soil related, climatic, and vegetational factors have made fires a natural occurrence there (A more extensive ecological study is now underway of the area, parts of which will be available soon). Over the past twenty years though, as home and business development in the hills intensified, the personal and property losses from these fires has been increasing. In 1961 a major fire destroyed about 450 homes and caused an estimated $25 million dollars damage. Several major fires in 1970 destroyed about 600 homes, caused an estimated $165 million dollars damage, and resulted in parts of Engel county being declared national disaster areas (most of the damage occurred in the county's largest city, Engelburg, and its surrounding suburbs). Such occasional large scale damage, combined with smaller annual losses, has made brushfires a major problem. Homeowners and businessmen are becoming more and more vocal in their demands for some kind of action. Insurance companies are alarmed by the increasingly larger amounts of money they are having to pay out in fire loss claims each year. The claims after the fires of 1970 alone were staggering. The Fire Department, the Regional Planning Commission, and the Board of Supervisors all agree that action is needed, probably something beyond the standard fire suppression and prevention programs (although the Fire Department is quick to point out that any new measures should be undertaken in addition to the fire suppression and prevention programs, not at their expense.). But while everyone agrees that action is needed, meetings, conferences, and hearings have failed to produce a consensus as to exactly what should be done. Conflicting interests and other problems the county faces complicate the matter.

The rapid growth over the past thirty years of Engelburg and its suburbs has not only pushed development into the hills, but resulted in a vast hodgepodge of urban and suburban sprawl that already covers most of the county lowlands (Note: Growth projections for 1990 in population and housing will be available soon.). Pollution, particularly of the air, has become a major political issue. Partially because of the overall environmental quality deterioration, there has been a movement of businesses out of the county. This, combined with the present business recession, is decreasing the county's tax income. At the same time, inflation is driving county costs higher and higher. Caught in this financial squeeze, the Board of Supervisors had been regularly increasing taxes. Anguished screams from taxpayers though, have forced the Board to turn to across the board budget cuts in all county agencies and services for the last two years. These cuts have helped, but the supervisors still face the prospect of some tax increases, something they would rather avoid in an election year.

There is no question that the brushfire problem involves many difficult decisions. But they have to be made -- and soon. The weather bureau reports that precipitation over the winter months (normally very rainy) was much lower than normal and the county faces a second successive long, hot, and dry summer.


Desert Area
Lowland Developed Area
Ocean
San Catala Island
San Cement Island
Not in true location
▨ Brushfire Hazard Areas

BRUSHFIRE HAZARD AREAS OF ENGEL COUNTY

POLICY 1

UPGRADE THE FIRE DEPARTMENT'S FIRE FIGHTING ABILITY BY PURCHASING NEW FIRE EQUIPMENT AND HIRING MORE PERSONNEL. THE REVENUE NECESSARY FOR THE ACTION TO COME FROM A GENERAL PROPERTY TAX INCREASE.

Up to now, the Fire Department has managed to provide adequate protection to all of Engel County. However, some of its equipment is beginning to show its age. While equipment breakdown rates have not yet become serious, they are increasing steadily. Budget cuts by the Board of Supervisors over the past two years, combined with inflation, have eaten deeply into equipment replacement funds. Hiring has also been reduced due to lack of funds. Finally, a program to put all brushland residences in a five minute response time of Fire Department personnel and equipment has had to be curtailed, and several newly built fire stations closed. These factors combined with the rapid rate of development in the brushland has caused the Chief of the Fire Department to notify both the Board of Supervisors and the Regional Planning Commission that, unless funding for equipment and personnel is increased, it will soon be unable to provide adequate protection to all of Engel County.

In the last several years, tax increases, for any reason, have had little support among homeowners. In fact, in one supervisors district the opposing party's candidate for supervisor won her primary easily, campaigning solely on the issue of no tax increases. Getting this particular tax increase accepted may present more of a problem because only one part of the county's population benefits from it (home and business owners in the brushfire hazard area).

POLICY 2

THE COUNTY BUILDING CODE WILL BE REVISED TO REQUIRE CERTAIN SAFETY FEATURES (LIKE FIRE RESISTANT ROOFS) BE BUILT INTO ANY HOMES CONSTRUCTED IN BRUSHFIRE HAZARD AREAS AND, IF NECESSARY, THE CONVERSION OF NON-FIRE RESISTANT ROOFS TO FIRE RESISTANT ROOFS IN EXISTING STRUCTURES. ALSO A NEW COUNTY ORDINANCE BE ENACTED THAT WOULD REQUIRE ALL PERSONS OWNING STRUCTURES IN BRUSHFIRE HAZARD AREAS CLEAR BRUSH A DISTANCE OF AT LEAST 100 FEET AWAY FROM THEIR STRUCTURES.

Evaluations of damage from the disasterous fires of 1961 and 1970 suggest that many homes were lost because flying embers set wood shingle roofs on fire or burning brush carried the fire to the houses. To decrease the danger in both these areas, the Fire Department and the Regional Planning Commission have, for years, been urging the adoption of a mandatory brush clearing ordinance and a revision of the building code. The insurance companies see both these actions as a way to reduce their risk. In fact, some companies are even beginning to offer discounts to their customers who have "approved" (that is, fire resistant) roofs, and/or clear brush from around their homes. However, because insurance rates are regulated by the state, the companies have been only been able to offer the discounts on a limited basis.

To date, most of the opposition to these proposed changes has come from developers and homeowners in brushfire hazard areas. The developers note that, by far and away, the roof style most preferred by home buyers is the wood shingle roof, which is not approved by the insurance companies. To outlaw it, they claim, would put them at a competitive disadvantage with other areas of the county. Brushland homeowners do not so much object to the idea of native brush clearing, as to the way the proposed ordinance is written. The strongest objections are to a part that requires the county to clear the brush if the homeowner does not. The county is then allowed to recover its expenses by increasing the homeowners taxes by the necessary amount. Homeowners also object to the distance they would be required to clear the brush-100 feet from around structures. Many homeowners agree with several angry letters to the editor that have appeared in the Engelburg Times recently. These are claiming the standards and procedures in the in the proposed ordinance were written without talking to the people they would affect and is just another example of arbitrary bureaucratic decision making.

POLICY 3

STRONG RECOMMENDATION BE MADE TO THE STATE INSURANCE REGULATORY COMMITTEE THAT THE RATES OF THE INSURANCE COMPANIES WHO WRITE FIRE INSURANCE BE DE-REGULATED.

It is obvious to everyone that over the years, increasing losses from fire have forced the insurance companies to pay out more and more in claims. The insurance companies say, however, that the losses are becoming so bad that they will soon have to get out of the business unless they are allowed to adjust their rates in brushfire hazard areas to a more realistic level. They add that de-regulation would also allow them to give lower rates to home and business owners who take steps to protect their property (for example: fire resistant roofs, brush clearance) and higher rates to those who don't. Furthermore, according to the companies, the present situation of fairly inflexible, across-the-board rates to all home and business owners in the county, is, in effect, making rates higher for home and business owners in non-brushfire hazard areas. This is because the companies are not getting enough income from the premiums of people in brushfire hazard areas to cover losses there, and they have to make up the difference in the rates of other people. Essentially, people in non-brushfire hazard areas are subsidizing the rates of people in high risk areas. This has not gone unnoticed by the media (Engelburg Times, November 8, 1975; February 12, 1976). The last article brought several dozen angry letters from homeowners in non-brushfire hazard areas. Although the Board of Supervisors has not commented publicly on the rate problem, it is known that several supervisors favor de-regulation as a way of sharing the cost of fire insurance among the homeowners fairly.

However, some homeowners and businessmen in the brushfire hazard areas (and even some elsewhere) think the companies are just using the brushfire problem as an excuse to get something they have been trying to get for a long time -- non-regulated rates. There is now way, they claim, that the insurance companies will ever lower their rates, even with de-regulation. Furthermore, they fear that if rates are de-regulated they will take sudden jump and continue climbing until they are out of sight.

POLICY 4

AREAS OF HIGH BRUSHFIRE RISK WILL BE REZONED, CHANGING THE ALLOWED LAND USES TO VERY LOW DENSITY TYPES LIKE RECREATION, OPEN SPACE, ETC., IN ORDER TO PREVENT FURTHER INTENSIVE DEVELOPMENT.

Several of the more outspoken members of the Regional Planning Commission have stated several times that the only real solution to the fire damage problem is to limit what is there to be damaged. They point out that because of the ecology of the area, brushfires are inevitable. So regardless of suppression and precautions taken in building homes, continued intensive development will result in continued higher damages. The Regional Planning Commission also sees this as a way to guarantee recreational and open space areas for the county residents at a time when these areas are becoming harder and harder to preserve. Many homeowners (particularly those in the hill areas) are sympathetic with this idea. By preserving nearby open space and recreational opportunities, they think they can maintain or even improve their property values. Others living elsewhere feel that restricting development in these areas will cause even more intensive development in their own neighborhoods -- something many do not want.

The strongest opposition, though, comes from developers. They see this policy as a threat to their livelihood. While they recognize the brushfire problem, they think it can be resolved in a better way. They also point out that severely limiting development in such large areas will cost the county dearly in both jobs _and_ money from tax income at a time when it needs it the most. These are two concerns that also trouble the Board of Supervisors, particularly in light of the county's pressing financial problems (and the upcoming election!).

This policy presents insurance companies with a dilemma. Restricted development will certainly reduce their losses, but at the same time it will also remove potential customers, not only for fire insurance, but for other types of insurance as well.

POLICY 5

FINAL AUTHORITY FOR LAND USE POLICY AND DECISION WILL BE TRANSFERED TO THE REGIONAL PLANNING COMMISSION FROM THE BOARD OF SUPERVISORS.

More and more people are beginning to question the policy set by the Board of Supervisors of maintaining and encouraging growth and development in the county ("Is Progress Really Our Most Important Product?", Engelburg Times, April 22, 1975). There is a strong feeling that the rapid growth of the past is responsible for the overall deterioration of environmental quality indicated by worsening air, water, and solid waste pollution problems (there are days the air is so bad that the children cannot go outside to play). The opinion has been expressed that the authority for land use policy and decision should rest with those best qualified to make them -- the professional planners. Many people feel the elected supervisors are too easily swayed by the lobbying and money of special interest groups, especially around election time. They point to the continued developement in the hills of Engel county despite the fire problem as an example of the influence of one special interest group -- developers. Although the staff of the Regional Planning Commission cannot express it publicly, most of them have experienced the frustrations of the political world. Many would favor such a change.

The county Board of Supervisors is violently opposed to the change. They counter that such an arrangement would be much less responsive to the needs and desires of the people. Appointees are not answerable to the people through the polls, they say. Industry and commercial interest groups are also concerned. They see the potential of having to deal with a more "insulated" layer of bureaucracy.

POLICY 6

BEFORE ANY ACTION IS TAKEN, A SPECIAL STUDY WILL BE COMMISSIONED, ACCOUNTABLE TO THE BOARD OF SUPERVISORS, TO INVESTIGATE THE BRUSHFIRE PROBLEM, EVALUATE ALTERNATIVE COURSES OF ACTION, AND MAKE APPROPRIATE RECOMMENDATIONS.

The Board of Supervisors is reluctant to take definative action until they have better information on which to base their decision. No in-depth studies have been done to look at the impact of the various alternative actions (for example: restrictive zoning, special ordinances, etc.) on the economy and the environment of the county. Without such information the majority of the supervisors feel any decision they make could end up causing problems in other areas and still not solve the brushfire problem. Both the Fire Department and the Regional Planning Commission agree that a study is necessary and are willing to cooperate fully.

Homeowners and business also agree that a study would be a good idea. They are afraid, though, that it would take at least several years to accomplish (particularly since it is being done by a governmental bureaucracy!). In the meantime, they want some action. Brushfires, they point out, don't wait for impact studies.

INTEREST GROUP GOALS
(Goal Notification Form)

HOMEOWNERS (Outside the brushfire hazard area)

( ) increase the marker value of their homes
( ) reduce property and other taxes
( ) reduce home maintenance and other building related costs
( ) increase the authority of the Regional Planning Commission
( ) increase and/or improve the county services (police, fire dept., etc.)
( ) maintain or improve the environmental quality of their neighborhood.

HOMEOWNERS (Inside the brushfire hazard area)

( ) increase the market value of their homes
( ) reduce property and other taxes
( ) decrease the fire hazard
( ) reduce home maintenance and other building related costs
( ) increase and/or improve county services (especially the brushfire fighting capacity of the fire department)
( ) increase the authority of the Regional Planning Commission
( ) maintain or improve the environmental quality of their neighborhood

HOME AND COMMERCIAL DEVELOPERS

( ) increase the area available for development
( ) decrease restrictions on how an area is developed and how that development is built
( ) encourage growth
( ) reduce building costs
( ) increase influence on the Board of Supervisors
( ) reduce or eliminate bureaucratic red tape necessary for approval of of developments'
( ) decrease the authority of the Regional Planning Commission
( ) decrease the fire hazard (but not at cost to them)

BOARD OF SUPERVISORS

( ) maintain or increase the county tax base
( ) maintain or improve public safety
( ) avoid, if possible, alienating major interest groups
( ) attract business and industry to the county
( ) increase employment opportunities for county residents
( ) maintain authority for making land use decisions
( ) improve county environment
( ) get re-elected

REGIONAL PLANNING COMMISSION

( ) control and direct growth in the county
( ) reduce the danger and damage from brushfires
( ) keep their job security
( ) try to be sure effective planning procedures are used in making land use policy and management decisions
( ) improve the quality of the environment within the county
( ) balance the influence of special interest groups on the Board of Supervisors
( ) provide the Board of Supervisors with accurate and objective information to base their decisions on.

INSURANCE COMPANIES

( ) encourage efforts to de-regulate premium rates
( ) increase the market for policies (at reasonable risk)
( ) satisfy policy holders and stockholders
( ) reduce risks in coverage (especially fire insurance)
( ) make the premium it charges for policies equitable with the risk taken whenever possible
( ) increase profits

FIRE DEPARTMENT

( ) provide good fire protection coverage for the county
( ) increase funding for manpower and equipment
( ) reduce damage and danger from brushfires
( ) reduce on-the-job dangers to personnel
( ) insure the brushfire hazard is taken into consideration when land use decisions are being made and development site plans are developed.

Instructor's Note: *These goals can be retyped or cut out and pasted on 5" x 9" cards, one card for each interest group. If you plan to have them rank their goals, include brief written instructions on each card. For example: "Rank your group's goals from most to least important, using a #1 for the most important, 2 for second most important, 3 for the third most important, etc." Have them indicate their ranking by message to you as part of Task C.*

INFLUENCE ALLOCATION FORM

Interest Group ________________

Round # _________

Alternative Policy:	Influence Units Allocated
1. Upgrade the Fire Department's fire fighting ability by purchasing new fire equipment and hiring more personnel. The revenue necessary to come from a general property tax increase.	
2. The county building code will be revised to to require certain safety features (like fire resistant roofs) be built into any homes constructed in brushfire hazard areas and, if necessary, the conversion of non-fire resistant roofs to fire resistant roofs in existing structures. Also a new county ordinance be enacted that would require all persons owning structures in brushfire hazard areas clear brush a distance of at least 100 feet away from their structures.	
3. Strong recommendation be made to the State Insurance Regulatory Committee of the state legislature that the rates of insurance companies writing fire insurance be de-regulated.	
4. Areas of high brushfire risk will be re-zoned changing the allowed land uses to very low density types like recreation, open space, etc., in order to prevent further intensive development.	
5. Final Authority for land use policy and decision will be transfered to the Regional Planning Commission form the Board of Supervisors.	
6. Before any action is taken, a special study will be commissioned, accountable to the Board of Supervisors, to investigate the brushfire problem, evaluate alternative courses of action, and make appropriate recommendations.	

INFLUENCE ALLOCATION SCORESHEET

Policy #	Round #	Interest Groups							
		Homeowners (inside brush-fire hazard area)	Homeowners (outside brushfire hazard area)	Fire Dept.	Regional Planning Commission	Board of Supervisors	Home and Commercial Developers	Insurance Companies	TOTAL
1	1								
	2								
	3								
	T*								
2	1								
	2								
	3								
	T								
3	1								
	2								
	3								
	T								
4	1								
	2								
	3								
	T								
5	1								
	2								
	3								
	T								
6	1								
	2								
	3								
	T								

*Total

POPULATION AND HOUSING PROJECTIONS FOR 1990
(Brushfire Hazard Areas Only)

	% change from 1970-1990	% of total county pop. growth 1970-1990	% change in housing units 1970-1990	% new total construction in county 1970-1990
Avlom	100.00	0.30	66.7	0.2
Berkely Hills	7.53	1.05	7.3	1.2
Calbasia	215.79	6.16	216.7	3.2
Maravu	91.67	1.65	77.8	0.9
Pas Vardes	10.81	3.00	16.7	2.9
Punte Hills	24.29	6.46	34.9	3.9
San Vincent/ Pasada	13.64	0.90	13.3	0.6
Whilier	4.83	1.95	7.7	2.2
San Clari Valley	170.83	12.31	185.7	6.3
Overall:				
Engel County	9.36	--	11.1	--
% of total county growth occuring in brushfire hazard areas	--	33.58	—	21.4

15

Exerpt from the Ecological Research Report on the Chaparral Brushland (in preparation)

Section 5 Fire Frequency

There is no question that fires will continue to occur in the chapparal brushland. The combination of highly flammable vegetation (primarily chamise), and long, hot, rainless summers guarantee that (see sec. 2, in preparation). One question that does need to be considered further, though, is how often fires occur naturally over one given area. The life cycle of the chamise is such that fires usually occurred after the plants reached maturity and began to die back (about 25-30 years). The older the plants get, the more dead brush builds up, increasing their flammability. This, in turn, increases the fire hazard. All this suggests a natural fire frequency of roughly thirty plus years (although younger chamise will burn, but not with the high intensity and rapid rate of spread that the mature brush will). Man's activities, though, have changed the natural pattern in two ways:

1. Providing ignition sources other than natural ones (campfires, cigarettes, etc.)
2. Effectively suppressing most fires and preventing them from spreading.

The result of the first has been an overall increase in the number of fires. The second, however, effective suppression, has kept most of those fires small. But effective suppression has also disrupted the natural fire frequency and allowed much larger areas of brush to mature and overmature, setting the stage for an occasional very large and destructive fire like the ones of 1961 and 1970. Consequently, as the population increases and fire suppression methods continue to improve, the number of fires can be expected to increase and their average size expected to decrease. But, because dead brush will continue to build up, periodic large and intense fires will be inevitable.

INSTRUCTIONS FOR THE INSTRUCTOR

Before the Simulation Game:

1. Go over the messenger's role with the person acting as the messenger.

2. Prepare needed copies of all forms, overhead cells (if you are using them for the scoring), and check to make sure there is enough room space available for the simulation game and conferences.

3. Form participants into groups.

During the Simulation Game:

1. Announce the beginning of round one.

2. About ten minutes into the first round, announce the availability of the Population and Housing Projections and a section of the report of the Ecology of the Brushland.

3. When the messenger brings you requests for conferences, assign a time and location for each conference, and have the messenger return the forms to each of the appropriate groups.

4. Five minutes before the round ends, announce that the Influence Allocation Forms will be due at the end of the round.

5. At the end of round one, announce that in order to be adopted at the end of the third round, a policy must be supported by a net influence point total of 325. At the end of each round, report the results fo the Influence Allocation Forms. Make sure participants know the scores you report are not cumulative. Reporting scores can be done in two ways: (1) Disclose only the total points earned by each policy (positive and negative); or (2) Disclose the point total for each policy and how each group voted. If you use the latter option, you may want to use an enlarged version of the Influence Allocation Scoresheet for recording and reporting the results.

6. At the end of the third round, post the final results. If you didn't report how each group voted at the end of the previous rounds, do so now.

7. Begin post-game discussion.

MESSENGER'S INSTRUCTIONS

1. At the start of the first round, give copies of the Current State of Affairs to each of the seven interest groups (if they have not already read them.

2. During each round, deliver any special bulletins from the instructor.

3. At the end of the round pick up the Influence Allocation forms from each group, and give them to the instructor.

4. Carry messages from one group to another, and give the second carbon to the instructor.

5. Do not communicate with the participants. Direct any questions to the instructor.

6. Requests for conferences should be given to the instructor, after the two groups involved have agreed on a time and place. Approved requests will be returned to groups when the instructor has provided the conference with a time and place.

EVALUATION SURVEY

Forest Service
Respondents

PART 1, Problem Areas and Use Potential

1. Clarity of Directions

1.1 How would you describe the directions for the instructor?

$\bar{x}$ = 3.16
sd = .958

1	3	8	6	1
1	2	3	4	5
very confusing and difficult to follow				very clear and easy to understand

1.2 Based on your experience, how do you think participants in a "process approach" or other workshop would find the directions?

$\bar{x}$ = 2.63
sd = .761

1	7	9	2	5
1	2	3	4	5
very confusing and difficult to follow				very clear and easy to understand

Comments: ______________________________

2. Estimated Time Frame for Tasks

In general, do you think the stated completion time for the tasks is:

$\bar{x}$ = 3.37
sd = 1.01

1	2	7	7	2
1	2	3	4	5
too long		just about right		too short

Comments: ______________________________

3. Lesson Plan/Objectives Relationship (Objectives stated on the last page of the lesson plan)

$\bar{x}$ = 3.67
sd = .485

Do you think the learning experiences provided by the lesson plan will result in the stated objectives being met:

		6	12	
1	2	3	4	5
poorly				excellently

Comments: ______________________________

4. Flow of Information

4.1 From the instructor's point of view, did you find the flow of ideas, con-

$\bar{x}$ = 2.89
sd = .809

1	4	10	4	
1	2	2	3	5
very confusing, hard to follow				very clear, easy to follow

4.2 How clear do you think participants in a "process approach" or other workshop would find the flow of information?

1	8	8	2	
1	2	3	4	5
very confusing, hard to follow				very clear easy to follow

$\bar{x} = 2.58$
sd = .769

Comments: ____________________

5. Ease of Use

Assuming that the appropriate site and materials are available, do you think this lesson plan would be:

1	4	8	6	
1	2	3	4	5
very difficult to facilitate				very easy to facilitate

$\bar{x} = 3.00$
sd = .882

Comments: ____________________

6. Materials

6.1 Given your present situation, would the materials required for the lesson plan:

	2	3	6	8
1	2	3	4	5
be too difficult to acquire*				be very easy to acquire

$\bar{x} = 4.05$
sd = 1.03

6.2 In your opinion, are the materials in (or required by) the lesson plan adequate for (check one):

6.21 the instructor? 18 yes 0 no 1 no opinion

6.22 the participant? 13 yes 4 no 1 no opinion

6.3 What other materials or information (if any) would you like to see:

6.31 for the instructor? no comment = 16
comment = 3

6.32 for the participant? no comment = 14
comment 3

Comments: ____________________

7. Use Potential

7.1 Given your present situation and the materials needed, could you (answer as many as apply):

7.1 a. use the entire lesson plan as designed. 14 yes 3 no

*either by making your own or purchase.

7.1 b. use individual tasks or series of tasks as designed. 12 yes 3 no

7.1 c. modify the tasks and/or discussion to suit your needs. 17 yes 1 no

7.1 d. use it as an idea source. 17 yes 0 no

7.1 e. not use it at all. 1 yes 4 no

7.2 Would you use this lesson plan (or parts of it) in the foreseeable future? 8 yes 7 no 4 don't know

If you answered "no" or "don't know", please indicate the reason(s) below: (check as many as apply)

7.2 a. I don't know enough about fire in the environment. 0

7.2 b. I'm not interested in the topic. 0

7.2 c. I don't think the participants would find the topic of value to them. 2

7.2 d. I don't think the participants would find the tasks interesting. 0

7.2 e. I think other topics are more important. 1

7.2 f. It doesn't fit into the process approach workshops or other program I'm involved in. 2

7.2 g. Other: See text.

Comments:

8. Based on your experience as a workshop participant and/or facilitator, how would you compare, on an overall basis, this investigation lesson plan with the four presently used in the process approach workshops? (Soil, Water, Forest, and Habitat)?

$\bar{x} = 2.84$
sd = 1.01

2	4	9	3	1
1	2	3	4	5
much less effective a learning experience		about as effective a learning experience		much more effective a learning experience

PART II: Adaptability

1. Adaptatiblity for shortening.

1.1 Do you feel this lesson plan can be adapted for shorter time periods by omitting various tasks? 12 yes 6 no

1.2 Which tasks do you think would be the best to OMIT to save time. Indicate your first choice with a 1 (first omitted), your second with a 2 (second omitted), etc. If you think the task should not be omitted, leave its space blank.

Task A 29* Task C 25

Task B 40 Task D 68

*Task omission scores, not number of respondents.

2. Adaptability for Task Use Out of Context

2.1 Do you feel there are any tasks in this lesson plan that could stand alone as a learning experience? 9 yes 4 no 4 don't know

2.2 If so, which ones? (check as many as apply)

Task A 9 Task C 1

Task B 4 Task B 5

PART III: Suggestions for Improvement

In the space below and/or on the lesson plan itself, please make any comments or suggestions which you think would improve the effectiveness of the lesson plan; or any other comments you may have on overall content, value, style, etc.

See text.

*****THANKS FOR YOUR HELP!*****

Teachers

EVALUATION SURVEY (C) Land Use, Interest Groups, and Fire

PART I, Problem Areas and Use Potential

1. Clarity of Directions

*How would you describe the directions for the instructor?

x̄ = 3.3
sd = .816

	1	2	3	
1	2	3	4	5
very confusing and difficult to follow				very clear and easy to understand

*Based on your experience as a teacher, how do you think your students would describe the directions on the task cards?

x̄ = 2.6
sd = 1.140

1	1	3		1
1	2	3	4	5
very confusing and difficult to follow				very clear and easy to understand

Comments: ______________________________

2. Estimated Time Frame for Tasks

*In general, do you think the stated completion time for the tasks is:

x̄ = 3.0
sd = 1.581

1	1	1	1	1
1	2	3	4	5
too long		just about right		too short

Comments: ______________________________

3. Lesson Plan/Objectives Relationship
(Objectives stated on the last page of the lesson plan)

*Do you think the learning experiences provided by the lesson plan will result in the stated objectives being met:

x̄ = 3.6
sd = .548

		2	3	
1	2	3	4	5
poorly				excellently

Comments: ______________________________

Survey 2

4. Flow of Information

*From a teacher's point of view, did you find the flow of ideas, concepts, and information:

$\bar{x} = 3.5$
sd = .837

		4	1	1
1	2	3	4	5
very confusing, hard to follow				very clear, easy to follow

*How do you think your students would find the flow of information?

$\bar{x} = 2.83$
sd = .753

	2	3	1	
1	2	3	4	5
very confusing, hard to follow				very clear, easy to follow

Comments: ____________________

5. Ease of Use

*Assuming that you had an appropriate site, the required materials, and the time available, do you think this lesson plan would be:

$\bar{x} = 4.286$
sd = .488

1	1	2		2
1	2	3	4	5
very difficult for you to use				very easy for you to use

Comments: ____________________

6. Materials

*Given your present situation, would the materials required for the lesson plan:

$\bar{x} = 3.66$
sd = .516

	2	4		
1	2	3	4	5
be too difficult to acquire*				be very easy to acquire

*either by making your own or purchase.

*In your opinion, are the materials in (or required by) the lesson plan adequate for (check one):

the instructor?	6 yes	0 no	0 no opinion
the student?	5 yes	0 no	1 no opinion

*What other materials or information (if any) would you like to see:

for the instructor? no comment = 5
comment = 1

for the student? no comment = 6

Comments: ____________________

7. Use Potential

*Given your present situation and the materials needed, could you (answer as many as apply):

a. use the entire lesson plan as designed? 2 yes 2 no

b. use individual tasks or series of tasks as designed? 3 yes 0 no

c. modify the tasks and/or discussion to suit your needs? 3 yes 0 no

d. use it as an idea source? 3 yes 0 no

e. not use it at all? 2 yes 1 no

*Would you use this lesson plan (or parts of it) in the foresecable future?

3 yes 1 no 1 don't know

*If you answered "no" or "don't know", please indicate the reason(s) below: (check as many as apply)

I don't know enough about the fire in the enironment.	0
I'm not interested in the topic.	0
I think other topics are more important.	0
I don't think my students would find the tasks interesting.	1
I don't think my students would find the topic interesting.	0
I don't think my students would find it of value to them.	1
It doesn't fit into the time frame I have to work in.	0
I can't get my kids outside.	0
It doesn't fit in with the present curriculum.	1
The format doesn't fit the way I teach.	1

Other: No comments

Comments: ____________________

8. Based on your overall experience as a teacher, what is your overall opinion of this lesson plan as an educational learning experience for the students in the age bracket you instruct?

	2	1	1	1	$\bar{x} = 3.2$
1	2	3	4	5	sd = 1.304
poor				excellent	

Comments: ____

PART II: Adaptability

1. Adaptability for shortening.

Do you feel this lesson plan can be adapted for shorter time periods (i.e. shorter than need to do the entire lesson plan) by omitting various tasks?

5 yes 0 no

Which tasks do you think would be the best to OMIT to save time. Indicate your first choice with a 1 (first omitted), your second with a 2 (second omitted), etc. If you think the task should not be omitted, leave its space blank.

Task A 9 Task C 9

Task B 0 Task D 8

3. Adaptability for Task Use Out of Context

Do you feel there are any tasks in this lesson plan that could stand alone as a learning experience?

3 yes 2 no 0 don't know

If so, which ones (check as many as apply)

Task A 1 Task C 1

Task B 1 Task B 0

PART III: Suggestions for Improvement

In the space below and/or on the lesson plan itself, please make any comments or suggestions which you think would improve the effectiveness of the lesson plan; or any other comments you may have on overall content, value, style, etc.

*****THANKS FOR YOUR HELP!*****

APPENDIX TWO

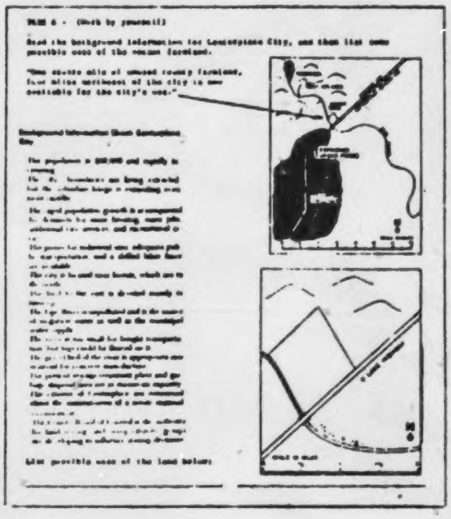
a lesson plan for:

A LAND USE SIMULATION

Set the stage for this investigation by reviewing quickly what will take place. For example: "During this activity we will participate in a simulation game concerning land use in a hypothetical community, analyze what we have done, and discuss some ideas and ways for you to develop your own simulation game about local environmental issues or concerns." The techniques used in simulation games combine elements of simulations, games, and role-playing. Participants assume the roles of decision-makers in a simulated environment and compete for certain objectives according to specified procedures and rules.

I. NAMING, RECORDING AND CLASSIFYING POSSIBLE USES OF LAND

1. Distribute TASK A. Read the problem to the group and then have them read the given information on TASK A and list possible uses of the land to meet the cities needs.
2. The problem is to identify some possible uses for the one-square mile (640 acres) of county farmland, four miles northeast of the city. It is now available for the city's use.



Investigating Your Environment Series
U.S. Forest Service
Portland, Oregon 1975

Questions and discussion

***Discussion Skills**

Accepting
Supporting
Encoura
Time to think
Clarifying

Note: When most people have started to write down uses on Task A, go ahead with question No. 1.

1. Ask "What are some possible uses for the undeveloped land?" As people respond, write all comments just as they are said. Don't paraphrase them if they are too wordy, ask: "How shall I write that on the chart?" List all suggestions, specific or general. Number the items as you go along--to simplify identification later. When you feel that you have enough material, go on to question No. 2.

2. Ask "Which of these possible uses are similar?" Designate similar uses by letters, symbols, or colors. When most are designated, or the group seems to run out of thoughts, STOP. Change items among categories if the participants change their minds. Don't get bogged down in the details of grouping. For example if some people think one use should be in another category, then put that use in both categories and go on to the next step.

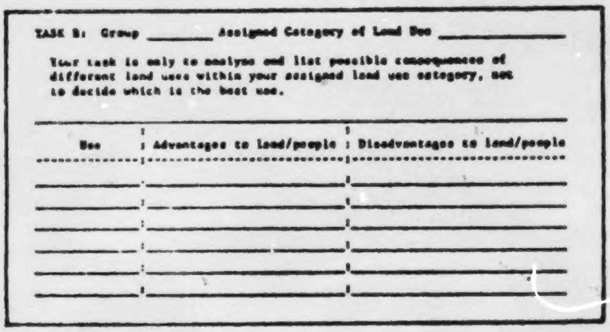
3. Ask "What label could we give to all the items in the same category?" e.g. Recreation, Industrial, Utilities, Housing, Commercial.

II. DEVELOPING AND GIVING PRESENTATIONS

1. Have the group count off into the number of land use categories. Groups should not be more than 8 persons. Assign one of the categories to each group for them to represent.

   One way to set up groups is to have the total group count off by the number of categories identified.

2. Pass out TASK B and inform the participants they have 10 minutes to list and analyze the advantages and disadvantages of possible uses for the vacant land in the assigned category. They may consider those listed on the board plus any other possible uses they can think of in their category. It is important to stress that this task is to just analyze the uses of the land.



TASK B: Group ________ Assigned Category of Land Use ______________

Your task is only to analyze and list possible consequences of different land uses within your assigned land use category, not to decide which is the best use.

Use	Advantages to land/people	Disadvantages to land/people

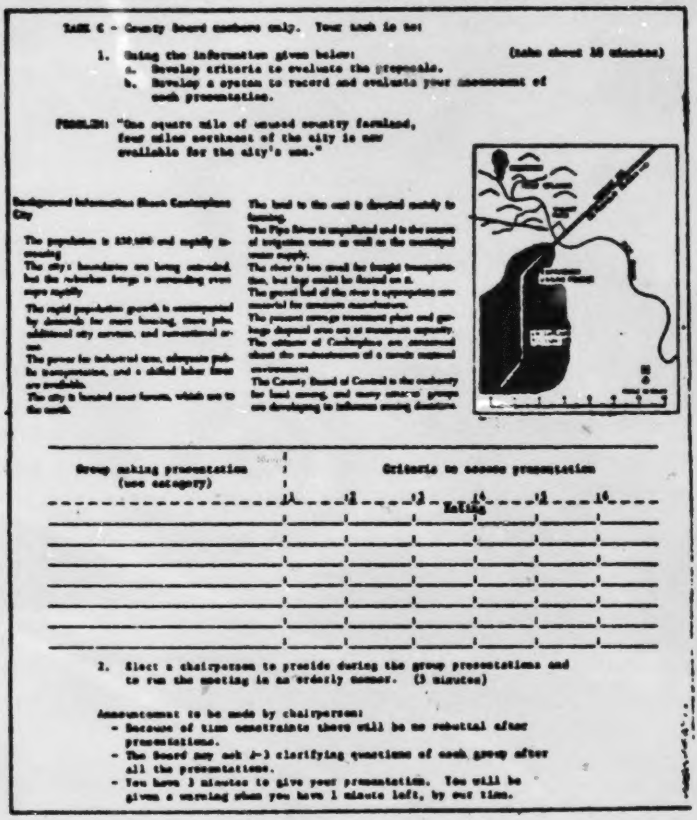
3. Tell the groups that their next task is to develop a land use plan for the area in their assigned land use category (about 20 minutes)

   NOTE: see 4b for additional direction after each group has started their planning. If all the directions are given at first, many groups start drawing a map before considering different land uses.

4. 3 minutes into their planning make the following two announcements.
   a. "We have just received word that due to the current workload from reading environmental impact statements the members of the Board of County Commissioners have all resigned. Each group has one minute to elect one member to represent them on the Board."

   b. Have one staff person take the new Board to another room and pass out TASK C. Review TASK C with them.

      (1) Have them concentrate on evaluation criteria first
      (2) Have chairman read and stick to the announcements at bottom of TASK C - in order to keep the process moving.



TASK C - County Board members only. Your task is to:

1. Using the information given below: (take about 30 minutes)
   a. Develop criteria to evaluate the proposals.
   b. Develop a system to record and evaluate your assessment of each presentation.

PROBLEM: "One square mile of unused county farmland, four miles northeast of the city is now available for the city's use."

Group making presentation (use category)	Criteria to assess presentation					
	1	2	3	4	5	6
				Rating		

2. Elect a chairperson to preside during the group presentations and to run the meeting in an orderly manner. (3 minutes)

Announcement to be made by chairperson:
- Because of time constraints there will be no rebuttal after presentations.
- The Board may ask 2-3 clarifying questions of each group after all the presentations.
- You have 3 minutes to give your presentation. You will be given a warning when you have 1 minute left, by our time.

   c. Make this announcement after Board leaves the room--You may have to give extra time for everyone to finish.

      "You have about 15 minutes to finish your plan and develop a 3 minute presentation to be made to the County Board of Commissioners. Your 3 minute presentation must include a visual display such as a land use map as a part of your presentation and more than one person in each group must participate in making the presentation." (Pass out felt pens and large paper.)

5. When all groups are ready have the County Board enter room and sit at the front. Appoint a time-keeper to cut off all presentations at 3 minutes (give 1-minute warning). Have chairman make announcements listed on Task C.

6. When 5 is finished, the Board retires for 5 to 10 minutes to select the best proposal.

7. While the Board is meeting, each small group develops a list of criteria which they think should be used in choosing between the plans submitted. (Pass out TASK C to use in developing the criteria.)

8. County Board re-enters the room and reads their criteria aloud.

9. County Board announces their decision and gives their reasons. Board adjourns.
Note: Person in charge must move rapidly to the next question to avoid shouting matches between losing groups. Have Board members return to the groups who selected them. The main purpose is to evaluate the process, not to get bogged down in the content of the issue.

Questions and discussion:

Accepting
Supporting
Encouraging
Time to think

1. What additional data would you like to have had for planning your group's proposal?

List on board, e.g.: Topography, vegetation, economy of area, railroad, shopping center, adjacent land, climate, soil survey, historical information, flood plain, wildlife, interest of board of control, money available, educational needs, regulations by State, existing zoning, political climate, population information (age needs, race, jobs).

2. Where would you go to collect information on these topics?

3. Point out to the group that this is one of the most important parts of the activity because it emphasizes that we need a variety of information and data before we can intelligently make a land management or environmental decision to best meet the needs of people and their environment. This list has many of the elements that need to be considered in studying a local environmental issue or concern. It also includes elements of all the curriculum subject areas (social studies, science, language, arts, etc.). Therefore we have to use the total community as a classroom or learning environment to collect the information.

4. Discuss any case histories of teachers or groups using this approach.

Optional if there is time, and it is pertinent to the situation, you may want to ask the following questions:

5. Did new leadership emerge during this session? What factors enabled this to happen?

6. Did your group work as a team? What did your group do to insure participation by all members of the group?

7. Were you assigned to a group or interest you didn't want to represent? How did you feel? Point out that many times we overlook that other people have different needs and ideas and this might be a way to identify them.

APPENDIX THREE

Script for:
"The Other Side of the Flame"

Visual	Audio
LS GIANT SEQUOIAS	❶...Opening music up full. PAUSE. (Approximately 8 seconds)
LS GIANT SEQUOIAS	❷...
LS GIANT SEQUOIA GROVE	❸...NARRATOR: These are the Giant Sequoias, largest living things on the face of the earth. They grow only on the western slope of California's Sierra Nevada Mountains.
LS GENERAL SHERMAN TREE	❹...The giant among giants here, the General Sherman tree, stands twenty-seven stories tall and has a base diameter of thirty feet. There is enough wood in this one tree to build fourty-five two bedroom houses.
MS KIRTLAND WARBLER	❺...This pretty little bird is a Kirtland Warbler, a rare and endangered species which breeds almost exclusively in young Jack Pine thickets of the lower Michigan peninsula. Only about five hundred of these songbirds remain.
MS KIRTLAND WARBLER, DIFFERENT ANGLE	❻...Strangely enough this little bird has something in common with the Giant Sequoias, something they both depend on to help insure their future generations. That something is .... MUSIC: Fade in music.
ECU BURNING MATCH	MUSIC: Build to climax...❼
ECU MATCH WITH TITLE	MUSIC: Fade under narrator. NARRATOR: ❽...Fire. PAUSE. (approximately 2 seconds).
MS TREE CROWNING OUT	❾...The idea that a plant or an animal might be dependent on a force that has the power to completely destroy it, may seem surprising.

LS LIGHTNING	⑩ ...Even the concept of fire as a naturally occurring element, like rain or snow, is an unexpected one. But in many areas of the country fires were a regular occurrence long before man made his presence felt.
MS FIRE KILLED VEGETATION	⑪ ...In these areas, through the process of natural selection, fire was, and is a major factor in shaping the type of plant and animal communities that developed.
LS MIXED CONIFER FOREST	⑫ ...The mixed conifer forest of the Sierra Nevada Mountains, which includes the Giant Sequoias, is one such community.
ARTWORK: CU 49'ER WRITING IN NOTEBOOK	⑬ ...When the forty-niners spilled over the Sierra Nevada Mountains into California, those who kept written records of their travels and experiences....
ARTWORK: LS 49'ER WRITING WITH SEQUOIA GROVE IN BACKGROUND	⑭ ...spoke almost to a man of the incredible park-like forests of the lower western slope. Stately columns of trees,....
ARTWORK: MINER STANDING NEXT TO SEQUOIA	⑮ ....some of them unbelievably huge, standing in groves or small irregular groups - nothing growing beneath them but grass,....
CU WILDFLOWER	⑯ ....and in the spring, myriad wildflowers carpeting the forest floor.
LS MIXED CONIFER STAND WITH GRASSY UNDERSTORY	⑰ ...For a moment, try to visualize the kind of fire that might occur in a forest such as this. ...PAUSE... Now listen to a description penned by John Muir, a noted naturalist, after he watched a brush fire race up the foothills and into the forest.
LS RAGING CHAPARRAL FIRE	⑱ ...Muir wrote: (ANOTHER VOICE) "It came racing up the steep chaparral covered slopes of the east fork canyon in a broad cataract of flames,

	now bending low to feed on the green bushes, devouring acres of them at a breath. But as soon as the deep forest was reached....
ECU GROUND FIRE	⑲ ....the ungovernable flood became calm like a torrent entering a lake, creeping and spreading beneath the trees where the ground was level or sloped gently....
ECU GROUND FIRE DIFFERENT ANGLE	⑳ ....slowly nibbling the cake of compressed needles and scales with flames an inch high, rising here and there to a foot or two on dry twigs and clumps of small bushes and brome grass."
LS GROUND FIRE IN MIXED CONIFER-SEQUOIA STAND	㉑ ...NARRATOR: Virtually all the fires that occurred in the mixed conifer forest were ground fires. Their very frequency, once every seven to nine years by one estimate, prevented them from becoming anything else.
MS BURNING FUEL	㉒ ...They happened so often that they removed the burnable material, or fuel from the forest floor; preventing it from building up and causing damaging fires.
MS BURNED OUT TREE	㉓ ...But even ground fires can kill mature trees if they generate enough heat to kill the thin layer of living tissue, the cambium, lying just underneath the bark.
CU CROSS SECTION OF TREE SHOWING BARK	㉔ ...All the common trees in the mixed conifer forest, however, have thick and fire resistant bark which protects the cambium from damage. This insulating bark is an adaptation that is most evident in Giant Sequoias, where it can reach two feet in thickness. But more happens here than just the survival of the trees.
LS ASH COVERED FOREST FLOOR	㉕ ...By consuming much of the built-up mat of needles, dead twigs, and other organic matter,....

ECU ROOTS.	㉖...the fire allows pine and sequoia seedlings to reach the mineral soil quickly. This greatly improves their chances for survival, especially the sequoias. Fire also helps the seedlings in another way; by providing readily available nutrients.
ARTWORK: FIRE FROWNING AT SMALL PUDDLE OF NUTRIENTS	㉗...Normally, the nutrients locked in this dead material are released only gradually as it slowly decomposes.
ARTWORK: FIRE TURNING ON FLOW OF NUTRIENTS	㉘...Fire quickly converts them to a more readily available form, leaving them behind in the ashes. In this way, fire provides fertilizer for the young seedlings.
MS DEAD CONIFER SAPLING	㉙...At the same time the fire creates good reproductive conditions, it also eliminates potential competition from species that are less fire resistant. Competition that would, in the absence of fire, eventually choke out and replace the Giant Sequoia and other fire adapted species.
CU REGROWTH	㉚...The trees are not the only residents of this forest that benefit. The plants on the forest floor usually put on a surge of new growth after a fire....
LS WILDLIFE	㉛....providing more succulent and nutritious forage for many of the animals.
LS GROUND FIRE IN MIXED CONIFER FOREST	㉜...In the Sierra Nevada Mountains, then, fire is an integral, natural and necessary part of the mixed conifer forest.
BURN THROUGH PREVIOUS SLIDE: "DECREASE FIRE HAZARD	㉝...It periodically removes fuel build-up, decreasing a major fire hazard....
BURN THROUGH: ABOVE PLUS: "REPRODUCTION"	㉞....creates excellent reproductive conditions....
BURN THROUGH: ABOVE PLUS: "NUTRIENT RECYCLING"	㉟...improves nutrient recycling

BURN THROUGH: ABOVE PLUS: "ELIMINATES COMPETITION"	㊱ ....and eliminates competition from fire-sensitive species. Thus, the very force that would destroy trees, becomes responsible for their maintenance.
LS JACK PINE FOREST.	㊲ ...Quite a different situation exists in the jack pine forests of the Great Lake states. Here fire occurs less frequently because of different climatic and vegetational factors.
LS FUEL BUILD UP	㊳ ...Decomposition is slow, allowing fuel to build up on the forest floor. When this is combined with the flammable nature of jack pine....
LS CROWNFIRE	㊴ ....the fire, when it does occur, can be very intense and damaging. Unlike what happens in the mixed conifers, a fire here may occur only once in the life of a jack pine forest, but it destroys most of the trees.
LS AFTERMATH OF A FOREST FIRE	㊵ ...Normally, one would expect this to quickly eliminate jack pine from the natural environment. But an unusual adaptation has turned its flammability into an advantage.
CU JACK PINE CONE	㊶ ...The peculiar cones of jack pine are heavily sealed with resin. Furthermore, the trees begin producing them at an unusually early age, about ten years.
MS BRANCH WITH MANY CONES ON IT	㊷ ...They remain on the tree, sometimes for as long as twenty years, accumulating as the tree grows older.
CU JACK PINE CONES OPEN	㊸ ...When the fire finally strikes, the heat melts the resin and releases the accumulated seeds. Even the seeds are heat tolerant, resisting temperatures as high as seven hundred degrees for as long as ten or fifteen seconds.
CU JACK PINE SEEDLING	㊹ ...Thus, even as one generation dies, it insures the presence of the next one. From this point on, the role of fire is similar to that in the mixed conifer forest.

CU JACK PINE SEEDLINGS.	㊺ ...Competition is eliminated, a good seedbed is created, and nutrients are released from the ash.
LS JACK PINE THICKET	㊻ ...It is, by the way, in these young jack pine thickets that the Kirtland warbler nests. Without fire or some artificial disturbance and reseeding method these young pines would not exist; and without them the Kirtland warbler would soon disappear.
LS FIRE IN JACK PINE STAND	㊼ ...As in the mixed conifer forest fire is a normal and necessary part of the jack pine environment. But instead of being a force for maintenance, it clears away the old forest to make way for the new. A sort of natural urban renewal.
SPLIT SLIDE: GIANT SEQUOIA/ KIRTLAND WARBLER	㊽ ...The two natural communities we have looked at are not unique or even unusual in their relationship with fire. In many other areas of the country fire plays a similar role.
LS PONDEROSA PINE FOREST	㊾ ...The ponderosa pine forests of the west....
LS OPEN SOUTHERN PINE FOREST	㊿ ....the pine forest of the south....
LS ROCKY MOUNTAIN FOREST	(51) ....the conifer forests of the Rocky Mountains....
LS WEST COAST FOREST	(52) ....and the Douglas fir forests of the Pacific coast, are all the result of periodic natural fires.
LS TALL GRASS PRAIRIE	(53) ...Even the original tall grass prairie ofthe midwest was, in part, maintained by fire. Unlike the Giant Sequoia, the above-ground part of the prairie plants were usually destroyed.
CU ROOTSTOCK	(54) ...But underground stems, buds, and rootstocks, insulated by a protective layer of soil, sprouted vigorously after a fire, replacing what had so recently been burned away.

LS BURNING PRAIRIE	(55) ...Today what little is left of the virgin tall grass prairie must be burned to preserve its true prairie character. PAUSE. Fire, however is not always a major environmental influence.
CU WATER DRIPPING OFF LEAF	(56) ...The hardwood forests of the east and south are generally humid in nature. The trees themselves make poor fuel, as anyone who has tried to use green wood for a fire knows.
CU DECOMPOSING STUMP	(57) ...Furthermore, decomposition is fairly rapid, reducing the fuel build-up. When these factors combine, the result is a forest that at times can become almost fireproof.
LS HARDWOOD FOREST	(58) ...There are, however, no absolutes in nature. Even here fires occur occasionally.
LS GROUND FIRE IN HARDWOOD FOREST	(59) ...But the size and intensity of fires in hardwood forests are greatly limited by the humidity and fuel conditions. For the most part, they are low intensity ground fires.
MS DEER BROWSING OR GRAZING IN HARDWOOD FOREST	(60) ...Where they do occur, the tender regrowth provides good forage for wildlife. In fact, in New England hunters regard burned over areas as deer bait.
LS SMALL MEADOW	(61) ...In those few cases where the fire manages to reach an intensity severe enough to kill the hardwoods, grassy meadows may develop.
MS WHITE PINE INVADING MEADOW	(62) ...Or the area may be invaded by conifers like white pine in the north or longleaf or slash pine in the south.
MS HARDWOOD REPRODUCTION INVADING MEADOW	(63) ...If left undisturbed though, the hardwood eventually reclaim the lost area.
LS GIANT SEQUOIA GROVE	(64) ...That fire is a natural force cannot be denied. In areas where enviromental. factors favor its periodic occurrence, it is a major factor in molding the natural community.

LS HARDWOOD FOREST	● ...While in other areas, it's influence may be considerably reduced by limiting factors.
MS MAN FIGHTING FOREST FIRE	(66) ...In any case, there is one agent of change that has had a major impact on fire itself -- man.
ECU FIRE	(67) ...Fire has always been a part of man's natural environment. Yet his attitude toward it has undergone several changes.
ARTWORK: VERY EARLY MAN RECOILING FROM FIRE	(68) ...In the beginning, fire must have been hated and feared, much like wild animals do today.
ARTWORK: CAVEMEN WARMING THEMSELVES AROUND FIRE	(69) ...Later, as man came to respect and use it as a tool, it became a warm friend on bitter nights....
ARTWORK: INDIANS DRIVING GAME WITH FIRE.	(70) ....or a way to obtain game.
LS URBAN AREA	(71) ...But as man divorced himself from the natural environment, his attitude toward fire changed again.
MS NEWSPAPER HEADLINE	(72) ...Think back to all the exposure you have had to fire in the natural environment -- ....
CU SAME NEWSPAPER HEADLINE	(73) ....newspaper articles and pictures, TV/radio news, movies, posters, billboards, anything that might have shaped your view of fire.
ECU SAME HEADLINE AROUND "RAGE"	(74) ...What kind of picture do you see developing?
MS DIFFERENT NEWSPAPER HEADLINE	(75) ...Now imagine millions of people all seeing and hearing the same message.
ECU PREVIOUS NEWSPAPER, AROUND WORK "HAVOC."	(76) ...What kind of attitude might they develop? How might it be expressed?
LS FIRE SUPPRESSION	(77) ...Until very recently, it was the the policy of public land management agencies to vigorously suppress any fire occurring on public land regardless of whether it had a natural or man-made origin.

MS BURNING HOUSE	(78)...Sometimes this reaction was necessary and desirable....
MS MAN FIGHTING GROUND FIRE	(79)....but in natural communities where fire played an important role, putting every one out produced some unexpected results.
LS MARIPOSA GROVE 1890	(80)...The natural make up of the communities began to gradually change as those plants adapted to fire failed to reproduce....
LS MARIPOSA GROVE, 1970	(81)....while other plants better suited to the new conditions move in.
MS WEEDY GARDEN	(82)...You can watch the same natural principle in action by not weeding your garden for a couple of months. PAUSE. In some areas, particularly the west, something much more noticable happens...
LS DEVESTATED AREA	(83)....larger and more destructive fires. Ironically, by putting out all fires, man had helped cause larger ones. When the smaller, periodic fires were suppressed, the fuel that was normally removed by them, built up. When a fire finally did occur, it was abnormally large and intense.
CU FIRE RESEARCH PAPER	(84)...But views are changing. Recent research by scientists and resource managers is clarifying fire's place in nature. Its role in the natural environment is being acknowledged by an ever increasing number of people.
MS MAN WORKING AT DESK	(85)...Fire management plans, tailored to regional needs, are being developed.
MS TWO MEN DISCUSSING PLAN	(86)...But because the ecology of fire is very complicated, decisions involving it are difficult.
CU PEN POINTING TO AREA ON MAP	(87)...When the needs and desires of man are included, the situation can become more complex.
LS GIANT SEQUOIAS	(88)...From an ecological standpoint, fire is often desirable for an area.

LS STEEP SLOPES	(89)...But if the area contains steep slopes, burning it may cause soil erosion which, in turn,....
MS MUDDY STREAM WATER	(90)...can affect water quality, water that man might want to use.
LS FOREST FIRE SMOKE	(91)...Smoke, carried by the winds, can temporarily reduce the air quality in nearby towns, and....
LS AFTER AFFECTS OF FIRE	(92)...while interesting to the ecologist the immediate aftermath of a fire is unappealing or even ugly to many who wish to use the area for recreation.
GRAPHIC: MONTAGE OF DIFFERENT LAND USES.	(93)...These, and other important people-related considerations complicate any decision a land manager has to make regarding fires use in land management. PAUSE. But land-use considerations involving fire may have to extend beyond its use as a management tool.
LS CHAPARRAL COVERED HILLS	(94)...These are the chaparral covered hills of Southern California.
LS CHAPARRAL FIRE	(95)...Fire is a natural element here, the hills burn periodically. Because of this, the natural communities have adapted themselves to fire.
LS HOUSES IN BRUSH COVERED HILLS	(96)...Unfortunately, the man-made communities built in these hills have not.
MS SAME HOUSES ABOVE	(97)...In one three-month period in 1970 alone, over 800 homes went up in the flames.
LS HOUSING CONSTRUCTION	(98)...These losses led to special laws requiring certain minimum safety features be built into any new homes If these precautions do not work....
LS HOUSING CONSTRUCTION, DIFFERENT ANGLE	(99)....then development of these areas may have to be restricted by appropriate zoning....
LS FLOODED AREA	(100)....much as is done today in many areas subject to periodic flooding.

LS FIRE	(101)...In California, and throughout the world, man and fire have always been a part of the same environment.
ECU HEADLINE	[illegible]...Man has feared fire....PAUSE....
LS FIRE SUPPRESSION	[illegible]...fought it...PAUSE....
LS CAMPFIRE	[illegible]...used it ...PAUSE....
CU CIGARETTE ON FOREST FLOOR	(105)...and abused it.
LS SILOUETTE OF PINE	(106)...But only now is he beginning to understand it's role in the natural order of things.
	MUSIC: Full up to end.

CREDIT SLIDES:

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APPENDIX FOUR

Simulation Games --
Claims and Criticisms

Any kind of communication strategy or methodology used in education, is used to accomplish a purpose, to bring the students to a point they were not at before. That point may or may not be specified by behavioral objectives. Opinions on just what simulation gaming can accomplish, however, are varied. The following is a summary, taken from a review of literature, of some of the things simulation games are supposed to be able to do.

1. Increase Student Motivation (Taylor 1972; Carlson 1969; Coleman and Boocock 1966; Boocock 1968; Smith 1972; Edwards 1973; Abt 1968; Livingston and Stoll 1973; Chartier 1973; Cherryholmes 1966; and Charles and Stadsklev, 1973). As one can see from the citations, quite a few people agree with this claim. Some of this increased motivation may come from just doing something new in the classroom (i.e. other than the standard lecture). But there may be more to it than that. Students, instead of passively listening, have the chance to do something, to interact on a student to student basis. A partial feeling of control over their (i.e. the student's) environment may also be a motivating factor.

2. Changes in the Teacher Role. (Taylor, 1972; Coleman and Boocock, 1966; and Boocock 1968). The teacher is divorced from an authoritarian, judgemental role. In a simulation game the rules come from the game environment. The teacher may take no role at all or serve as a guide or motivator (except in the post-game discussion). This removes or at least "fuzzes"

the usually sharp "me Tarzan, you Jane" teacher/student role boundaries.

3. Teaches Decision-Making and Strategy Formulating Skills. (Boocock and Shild, 1968; McLean 1973; Edwards 1973; Abt 1968; Carlson 1969; Taylor 1972). Since simulation games put players in situations which require making decisions, it seems logical that such games should teach decision-making skills. Strategy skills could be taught too, since players must form strategies to win (if only what Schild, 1966, calls "winning strategies").

4. Teaches Problem-Solving Skills. (Abt 1968; Chartier 1973). Again a logical conclusion since simulation games confront students with a problem of some sort that has to be resolved.

5. Allows Learning to Occur at Diverse Levels. (Edwards 1973; Smith 1973; Chartier 1973; Livingston and Stoll 1973; Taylor 1972; Boocock and Schild 1968; Coleman and Boocock, 1966). The open-ended nature of simulation games offer learners the opportunity to uncover principles, relationships, and structures on a variety of different levels.

6. Accomodate a Broad Range of Student Learning Abilities. (Abt, 1968; Edwards, 1973). By offering diverse levels of learning, simulation games can also accomodate students of different learning abilities. A little of the "something for everyone" idea.

7. Develop Role Awareness (Taylor 1972; Boocock, 1968). By playing a role in a simulation game, players can, to a limited extent, literally "step into someone else's shoes." Consequently the student may empathize with the role (and people in the real world in that situation), which could to (7) below.

8. Develop or Change Attitudes (Boocock and Schild, 1968;

Livingston and Stoll, 1973; Chartier, 1973; McLean, 1973). Developing empathy for a role or understanding the nature of a problem or issue may bring about an attitude change in the player.

9. Allow Compression of Time. (McCluskey, 1973; Taylor, 1973). Processes that normally take days, months, or even years, can be simulated in minutes or hours.

10. Allows Students to Sample Aspects of Reality. (Carlson, 1969; Coleman and Boocock, 1966; Taylor, 1972; Coleman, 1968; Livingston and Stoll; Raser 1969). One of the major advantages of simulation, it has the potential to provide a vivid link to the real world, something that can help increase the relevancy. According to Coleman and Boocock (1966), simulation games can help correct a defect they see in secondary education -- a mismatching of time. The student is not being taught for the present, but for the future whose needs have not yet impressed themselves on students. Consequently students see little need for the things they are studying. Simulation gaming can help bring the future to the present "....allowing the child to play roles in a large differentiated society of which he otherwise hardly gets a glimpse....and surround(s) the child with an environment which is artificial for the present but realistic for the future." Bridging the reality gap can help bring alive material in textbooks that seems flat or abstract and give a student a more intimate -- and relevant -- contact with the real world.

11. Provide Useful Points of Departure for Discussion. (Carlson, 1969). Although not mentioned often, the debriefing may not only offer discussion possibilities, but also jumping off points for other investigations or activites.

The above is by no means a complete list. For example, Greenblat (1973) identified twenty-nine separate claims under six general headings. Complete or not, it seems that if simulation games could do everything they are claimed to do, they would be the best thing to hit education since federal funding. Like every other educational technique, however, simulation games have their limitations.

Paradoxically, one of the biggest advantages of simulation games also draws the most criticism -- simplifying reality (Carlson, 1969; Edwards, 1973). Simplifying reality may introduce distortion, leaving out factors, over-emphasizing some and under-emphasizing others. Even if the factors are there, their relationships may turn differently in the game than in real life. In fact, Kraft (1967) has claimed games can obscure more than they reveal. Related to this potential problem is the possibility that students, understanding the game's simplified version of reality, may also think they understand reality as well. This could lead to all sorts of misconceptions (or worse, if the students act on their knowledge!). Both these problems reflect the need for careful design and follow-up discussion.

The limitations and criticisms of simulation games fall into three categories: Problems inherent in the method, problems in implementation in a school setting, and teacher attitudes toward the strategy.

Since simulation games are competitive, they have been criticised for putting too much stress on winning. Students may be so concerned about winning that they may miss some of the real objectives of the game. Dill (1966) observed this happening in a game he was studying. An extension of this criticsm is the claim, noted by Carlson (1969) that simulation games "dehumanize" because they allow players to maneuver the lives of others (in the game context) to benefit themselves without being subjected to real world constraints. This effect could be magnified if the student sees the simulation game as being equivalent to the real world. On the other hand, manipulation is a part of the real world. Whether or not simulation games distort that manipulative aspect of reality by removing constraints depends on the game and the situation.

Another related criticism is the concern that simulation games may present an unrealistic picture of psychological motivation. Some kind of countable entity must be used to help distinguish between winners and losers, be it points, dollars, satisfaction units, jellybeans, or whatever. However, some rewards people seek are not quantifiable and so could be overlooked. All these criticisms mentioned are problems inherent in the method itself. They can be lessened by careful design, implementation, and follow-up discussion, but probably never completely eliminated.

Much more tangible than the limitations noted above, are those practical ones dealing with use in a school setting. Even though simulation games can compress real time, their game time frame may not fit easily into the school's time frame (e.g. 40 minute periods). Rearrangement of the physical classroom structure or more space than is available. Other problems include cost and availability. Some simulation games, although fitting for what the class is doing, may cost $40 - $50, an expensive outlay for a school on a tight budget. Even if the school is willing to pay that much, the game may not be available for use in time. Finally, because simulation games involve active student interactions, they are often noisy and seemingly chaotic.

The third general limitation lies not in the method, but in the potential users. Many educators still look on any classroom activity that is "fun" as precluding "learning something." They may not regard simulation games as serious educational activities and distrust their intellectual validity. Furthermore, many teachers are unfamiliar with the management role required by simulation games instead of the more typical authoritarian one. The switching of roles may seem threatening. Teachers may be concerned about what students will do if given a freer atmosphere, and so inhibit the use of such educational strategies. Perhaps Horn and Zuckerman (1972) offered the best summary of teacher fear: "....not a few teachers are possessed by nightmarish visions of being buried in a welter of playing forms, role descriptions, and discussion questions while their students bounce off the walls in happy, screaming chaos."

To game, or not to game, that is the question. As can be seen from above, there are differing opinions as to the answer. In an attempt to get a more definitive answer about what simulation games can and cannot do, research investigating the use of simulation games was checked.

Active research in the area of educational simulation games has been going on since the early 1960's. Given the variety of claims, one would expect a variety of research exploring different areas. Although there have been attempts to investigate different areas, the bulk of the studies seemed to be concerned with comparing the relative success of simulation games and more traditional methods (i.e. lecture/discussion) in achieving cognitive and affective objectives. Table one is a summary of a review of twenty five studies[1] involving simulation games, indicating the results of the study and what other teaching method with which the simulation game was compared. Note that in a large majority of the studies the alternative educational method was lecture/discussion. Two conclusions can be drawn from the indicated studies: (1) Simulation gaming is no worse (and no better) than more conventional methods in teaching facts and concepts, and (2) Simulation gaming can be used to teach or change attitudes and are superior to more conventional methods in that respect. Even though other studies have been exploring a few other areas (Monroe, 1968; Livingston and Kidder, 1973; Lucas, 1974;Curry and Brooks, 1971; Keach and Pierty, 1972 -- see table for areas concerned.), these are too few to draw any definite conclusions. Some authors (Greenblat, 1973; Fletcher, 1971) even caution against drawing conclusions from studies concerning facts, concepts, and attitudes, noting a number of problems with research design in many studies (e.g. the failure to concider the Hawthorne effect, biases or poorly selected test populations, lack of control for student characteristics, single studies on particular games). Finally, when drawing conclusions from a number of different studies, each study on a different game, the assumption is that simulation games are homogeneous, despite variations from one to the next.

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[1] This is by no means a complete review of the research available, but it does give an idea of where research in this area has been going.

What does all this mean? In the case of research, it means more carefully designed research efforts are needed to check aspects of simulation gaming other than factual learning or attitude changing ability. This need has already been recognized in more extensive research reviews (Greenblat, 1973; Wentworth and Lewis, 1973; Fletcher, 1971). It also means research has yet to confirm or deny most of the claims -- pro and con -- about what simulations can or cannot do.

	Study	Facts and Concepts	Attitudes	System Dynamics	Theory	Retention	Critical Thinking Ability
L[1]	Hsiao (1975)	no sig. dif.[2]					
L	Hegarty(1975)		sim.				
L	Livingston(1970)		sim.				
L	Stadsklev (1969)	no sig. dif.					
L	Monroe (1968)			sim	lect/dis		
L	Garvey & Seiler (1966)	lect/dis	no sig. diff.				
S,L	Chartier (1972)	no sig. dif.	sim.				
S, RP	Livingston & Kidder (1973)		sim.	sim.			
L	Vogel (1973)		sim.				
L	Alley & Gladhart (1975)		no sig. dif.				
L	Wentworth & Lewis (1973)	lect/dis					
L	Heinkel (1970)	no sig. dif.					
L	Lucas (1974)	no sig. dif.				sim.	
none	Carr & Manning (1973)		sim.				
S,L(M)	Fennessey (1972)	no sig. dif.					
L	Postma (1975)		sim.				
L	Baker (1968)	sim.	sim.				
S	Boocock (1968)	sim.	sim.				
	Curry & Brooks (1971)	no sig. dif.	sim.				no sig. dif.
	Keach & Pierty (1972)	no sig. dif.				sim.	
	Troyka (1973)	sim.					
CS	Anderson (1970)	no sig. dif.					
L	Lee & O'Leary (1971)		sim.				
L	Wing (1966)	no sig. dif.					
L	Livingston 1971)	no sig. dif.				no sig. dif.	

[1] Method simulation compared to: L = Lecture/Discussion, RP = Role Playing, S = other simulation L(M) = Lecture/Discussion with emphasis in media.

[2] Results of study. The method noted is the method that was significantly superior.

TABLE 1 A Summary of Simulation Game Research

However, this does not mean simulation games should not be used as an educational method. Research has indicated that they are able to convey facts and change attitudes, and there seems no question that they motivate students. But even though research has not confirmed it, there is probably more to simulation gaming. They can provide the student with a glimpse into an increasing complex world and despite potential problems of simplification of reality, that may be helpful for the student in the long run. Which of us has not felt bewildered at one time or another by the complexity of the world we live in? And if reality can bewilder us, imagine what it might seem like to someone who has not had the practice dealing with it. Perhaps there might be some advantage in getting a little "practice" by dealing with toned down versions. There also might be some advantage in practicing decision-making and problem-solving also offered by simulation gaming. But perhaps one of the best reasons of all is that simulation games can be "fun." And what is wrong with making learning fun once in a while?

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